NUCLEAR SCIENCE ABSTRACTS

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GENERAL

ATOMIC POWER

13224 AERE-CE/R-2257
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
CONFERENCE ON THE UTILISATION OF HEAT FROM NUCLEAR REACTORS HELD AT HARWELL ON JANUARY 18, 1957. C. M. Nicholls, ed. 1957. 70p.

Seven papers are included which present possible applications of nuclear heat to chemical, coal, and metals industries, and national water purification. The discussion following each paper is also given. (D.E.B.)

13225
ATOMIC ENERGY IN INDUSTRY. 5TH ANNUAL CONFERENCE. New York, National Industrial Conference Board, Inc., 1957. 283p. $15.00.

Papers are included on prospects for economic nuclear power, commercial power reactors—natural and enriched fuels, the development of better products through radioisotopes, new products through radiation chemistry, chemical processing and waste disposal, new markets created by atomic age metals—Zr, Ti, Hf, Be, Th, refractory metals and ceramics, realization of market potentials in atomic energy, reactor safety, atomic energy legislation, safety and health problems, the long range outlook for nuclear industries, and atomic energy developments abroad. (M.H.R.)

13226
MAJOR ACTIVITIES IN THE ATOMIC ENERGY PROGRAMS, JANUARY–JUNE 1957. Washington, U. S. Government Printing Office, July 1957. 274p. $0.75.

A general summary of USAEC activities is given. Included in the appendices are the organization, principal staff, and membership of committees of USAEC; major research and development installations; radioisotope distribution data; commission-owned patents; publications and regulations; production, utilization facility, and special nuclear materials licenses applied for and issued; health and safety procedures for 1957 nuclear tests; a paper on fall-out by Dr. Libby; nuclear reactors built, building or planned in U. S., and additional details on reactor fuel. (M.H.R.)

BIOLOGY AND MEDICINE

13227 AEC-tr-3035
A STUDY OF THE RESPIRATION OF OBLIGATE ANAEROBES. G. M. Frenkel and M. K. Karpenko. Translated from Mikrobiol. Zhur., Akad. Nauk Ukr.R.S.R. 15, 6-16 (1953). 23p.

The anaerobes Cl. acetobutylicum, Cl. felsineum, Cl. welchii, Cl. sporogenes, Cl. butyricum, and Granulobacter peclinovorum consume and eliminate CO_2 in the presence of glucose. The process is energetic and corresponds to true respiration. The poisons NaF, 2,4-dinitrophenol, and NaCN inhibit the respiration process in the Cl. acetobutylicum and Cl. butyricum, and NaF and 2,4-dinitrophenol inhibit the P consumption from the medium. (R.V.J.)

AEROSOLS

13228 USNRDL-TR-158
Naval Radiological Defense Lab., San Francisco.
PERFORMANCE CHARACTERISTICS OF AN AEROSOL CONTAMINATION CHAMBER AND STUDY OF DECONTAMINATION METHODS. R. K. Fuller, W. B. Lane, and L. L. Wiltshire. Apr. 10, 1957. 23p. Project NS 088-001.

The contaminating characteristics of a new radioactive seawater aerosol contamination chamber were determined from size distribution of the aerosol fog at two points in the chamber by the water sensitive film technique from chloride analyses that gave the total mass of material deposited as a function of exposure time, and by gamma counting each exposed sample. Relative effectiveness of four decontamination methods was established. It was also shown that the amount of residual radioactivity approached a constant value independent of the initial activity. (auth)

RADIATION EFFECTS

13229 ACRH-7
Argonne Cancer Research Hospital, Chicago.
SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION. Leon O. Jacobson, ed. Mar. 1957. 88p. Contract AT-(11-1)-69. $0.50(OTS).

Progress is reported in studies on the biological effects of deuterium in mice; the effects of injected cell suspensions on the development of cataracts in irradiated mice; tracer studies on the metabolism of progesterone during pregnancy; tracer studies on cholesterol metabolism and steroid synthesis; development of a test for the determination of taurine in urine; the validity of using tritium self-radiation labeling in biochemical tracer studies; the preparation of labeled digitoxin by the tritium self-radiation method; studies on the tissue distribution, excretion, and placental transfer of radioactive digitoxin in human beings; and the feasibility of counting double-labeled compounds of tritium and C^{14} using a liquid scintillation counter with a two channel pulse height analyzer. Results are included from a theoretical study of the effect of variables on the shape of the electron energy spectrum and beam current of the ACRH linear electron accelerator. (For preceding period see ACRH-6.) (C.H.)

13230 AF-SAM-57-110
Texas. Univ., Austin. Radiobiological Lab. and School of Aviation Medicine, Randolph AFB, Tex.
NEOPLASMS IN MONKEYS (MACACA MULATTA): SPONTANEOUS AND IRRADIATION-INDUCED. Sidney P. Kent and John E. Pickering. Mar. 27, 1957. 14p.

13231 AF-SAM-57-119
School of Aviation Medicine, Randolph AFB, Tex. and Texas. Univ., Austin.
EFFECT OF RADIATION ON CREATINE SYNTHESIS IN THE DOG. Donald R. Anderson, Betty Joseph, Clyde M. Williams, and George M. Krise. Apr. 17, 1957. 8p.

13232 AF-SAM-57-126
School of Aviation Medicine, Randolph AFB, Tex. and Oak Ridge National Lab., Tenn.
EFFECT OF A CHRONIC EXPOSURE TO FAST NEU-

TRONS ON THE DEVELOPMENT OF TUMORS IN THE RAT. Quentin L. Hartwig, Sidney P. Kent, and James A. Sproul, Jr. May 9, 1957. 6p.

13233 PB-121962
Illinois. Univ., Urbana.
STUDIES ON RADIATION STERILIZATION OF SLICED APPLES. Report No. 5 (Final) [for] August 15, 1955–August 14, 1956. R. T. Milner. 78p. Contract DA19-129-QM-513.

13234 UCSF-15
California. Univ., San Francisco. School of Medicine. Radiological Lab.
SEMIANNUAL REPORT FOR PERIOD ENDING JUNE 30, 1957. Aug. 1957. 30p. Project No. 2. Contract AT-11-1-GEN-10. $1.00(OTS).

Routine operation of the synchrotron is reported. Data are presented from studies on the late effects of whole-body x irradiation in mice; the transplantation of tumors in rats; and cell division and cell size after lethal dose of x radiation in microorganisms. The clinical conditions of cancer patients treated with the 70-Mev synchrotron are summarized. (C.H.)

13235
ON THE EFFECTS OF X RADIATION ON THE STATE OF PLACENTARY BARRIER AT DIFFERENT PERIODS OF PREGNANCY. L. D. Luk'yanova (Inst. of Biological Physics, Acad. of Sciences, U.S.S.R.). Doklady Akad. Nauk S.S.S.R. 114, 1217-19(1957) June 21. (In Russian)

13236
GENETIC VARIATION IN THE ACUTE LETHAL RESPONSE OF FOUR INBRED MOUSE STRAINS TO WHOLE BODY X-IRRADIATION. Douglas Grahn and Katherine F. Hamilton (Argonne National Lab., Lemont, Ill.). Genetics 42, 189-98(1957) May.

13237
CYTOGENETIC EFFECTS OF X-RAYS AND THERMAL NEUTRONS ON DORMANT TOMATO SEEDS. Paul Yagyu and Rosalind Morris (Univ. of Minnesota, St. Paul and Univ. of Nebraska, Lincoln). Genetics 42, 222-38(1957) May.

13238
EFFECTS OF VARIOUS CATION IMBALANCES ON THE FREQUENCY OF X-RAY INDUCED CHROMOSOMAL ABERRATIONS IN TRADESCANTIA. Dale Steffensen (Brookhaven National Lab., Upton, N. Y.). Genetics 42, 239-52(1957) May.

13239
ADDITIONAL EVIDENCE ON THE EFFECT OF X-RAY AND ULTRAVIOLET RADIATION ON MUTATION IN MAIZE. M. G. Nuffer (Univ. of Missouri, Columbia). Genetics 42, 273-82(1957) May.

13240
INDUCED CHANGES IN FEMALE GERM CELLS OF DROSOPHILA. III. THE EFFECT OF MATERNAL DEHYDRATION ON OVIPOSITION RATE AND MORTALITY OF X-RAYED OOCYTES. Irwin H. Herskowitz (Indiana Univ., Bloomington). Genetics 42, 289-98(1957) May.

13241
POSTIRRADIATION CREATINURIA IN MACACA MULATTA. George M. Krise, Clyde M. Williams, and Donald R. Anderson (Univ. of Texas and U. S. Air Force, Austin). Proc. Soc. Exptl. Biol. Med. 95, 764-6(1957) Aug.-Sept.

13242
EFFECTS OF IONIZING RADIATION ON PROTEINS IN THE CYTOPLASM OF LIVER CELLS. L. I. Il'ina, V. D. Blokhina, and M. S. Uspenskaya. Med. Radiol. 2, No. 4, 23-30(1957) July–Aug. (In Russian)

13243
EFFECTS OF WORK ON THE CLINICO-MORPHOLOGICAL CHARACTERISTICS OF ACUTE RADIATION SICKNESS. L. N. Udgodskaya and Yu. G. Yudin. (Moscow Region Research Clinical Inst.). Med. Radiol. 2, No. 4, 68-74 (1957) July-Aug. (In Russian)

13244
CHANGES IN LUNG AND PLEURA FOLLOWING TWO-MILLION-VOLT THERAPY FOR CARCINOMA OF THE BREAST. Doris Bate and Ruth J. Guttmann (Columbia Univ. Coll. of Physicans and Surgeons, New York). Radiology 69, 372-83(1957) Sept.

13245
EFFECTS OF GAMMA RADIATION ON COLLEMBOLA POPULATION GROWTH. S. I. Auerbach and D. A. Crossley, Jr. (Oak Ridge National Lab., Tenn.) and Manfred D. Engelman (Univ. of Michigan, Ann Arbor). Science 126, 614(1957) Sept. 27.

RADIATION HAZARDS AND PROTECTION

13246 NP-6394
Norway. Defence Research Establishment and Sweden. Research Inst. of National Defence, Stockholm.
RADIOACTIVE FALLOUT OVER THE SCANDINAVIAN PENINSULA BETWEEN JULY AND DECEMBER 1956. A JOINT REPORT. P. B. Storebo and K. Edvarson. 7p. $0.50(OTS).

13247 UCLA-406
California. Univ., Los Angeles. Atomic Energy Project.
THE DISTRIBUTION OF PLUTONIUM IN THE SOILS OF CENTRAL AND NORTHEASTERN NEW MEXICO AS A RESULT OF THE ATOMIC BOMB TEST OF JULY 16, 1945. J. H. Olafson, H. Nishita, and K. H. Larson. Sept. 19, 1957. 25p. Contract AT-04-1-GEN-12. $0.75(OTS).

13248
GAMMA RADIATION FROM SOME SWEDISH FOODSTUFFS. R. M. Sievert, S. Gustafsson, and C. G. Rylander. Arkiv Fysik 12, 481-9(1957).

The γ radiation from powdered milk, beef, bone from cattle, and vegetables, collected and preserved in the years 1952 to 1956, has been investigated in May to September 1956 by means of two high-pressure ion chamber apparatuses placed in a low-background laboratory. In every case a significant increase was observed which seems to originate from fallout from atomic bomb tests. Investigations of the γ radiation from children have been repeated, but no increase could be observed in comparison with earlier tested subjects in approximately the same age and weight classes (101 subjects, 1954; 79 subjects, 1956). (Some further measurements of γ radiation from powdered milk, beef, bone, and thyroid from grazing cattle have been added in the proof.) (auth)

13249
MAGNITUDE OF BIOLOGICAL HAZARD FROM STRONTIUM-90. H. B. Newcombe (Atomic Energy of Canada, Ltd., Chalk River, Ontario). Science 126, 549-51(1957) Sept. 20.

13250
ATOM BOMB EFFECT. RECENT INCREASE OF CARBON-14 CONTENT OF THE ATMOSPHERE AND BIOSPHERE. T. A. Rafter and G. J. Fergusson (Department of Scientific and Industrial Research, Lower Hutt, N. Z.). Science 126, 557-8(1957) Sept. 20.

RADIOTHERAPY

13251
PRESENT STATUS OF COBALT-60 TELETHERAPY IN THE MANAGEMENT OF THE CANCER PATIENT.

Gilbert H. Fletcher. J. Am. Med. Assoc. 164, 244-8 (1957) May 18.

Cobalt-60 teletherapy is essentially a form of supervoltage radiation. There is no specificity of action on cancers by the various modalities of supervoltage, and it is a misconception to suppose that Co^{60} teletherapy has something to offer when 2-million-volt x-ray therapy has not. Both offer the possibility of increasing the dosage of radiation to tumors because of better skin tolerance and a slight increase in tolerance of the deeper structures. But both must be used with due regard to the possible later appearance of subcutaneous and deep muscle fibrosis and other signs of cumulative damage, and the curability of a tumor is one of its fundamental biological properties. Supervoltage or Co^{60} teletherapy is not indicated in a number of conditions, e.g., lymphomas in areas of superficial lymph nodes. Its use is elective in a number of other conditions, e.g., mediastinal and retroperitoneal lymphomas. Its use is imperative in a considerable number of conditions, including cancers of the oropharynx and urinary bladder and late cancers of the cervix and vagina. It has technical advantages that need to be explored further, but an objective and unemotional approach is necessary. (auth)

TOXICOLOGY STUDIES

13252 AERE-CE/M-198

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

MERCURY HAZARDS AND HANDLING. T. A. J. Jaques and J. G. S. Biram. May 1957. 14p.

Recent experiences in controlling mercury in the laboratory are summarized. 45 references. (auth)

13253 AERE-MED/M-17

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

CADMIUM POISONING. Frances M. Turner. May 1957. 10p. $0.32.

Acute and chronic cadmium poisoning and prophylactic and therapeutic measures are discussed. 71 references. (C.H.)

13254

EFFECT OF VITAMIN D ON RETENTION OF RADIUM BY THE WHITE RAT. Robert Hiltibran, F. E. Hoecker, and R. C. Mills (Univ. of Kansas, Lawrence). Proc. Soc. Exptl. Biol. Med. 95, 772-4(1957) Aug.-Sept.

TRACER APPLICATIONS

13255

MEASUREMENT OF THYROID CLEARANCE OF PLASMA IODIDE. THE EFFECT OF EXPANSION OF THE IODIDE SPACE. Arthur L. Kretchmar, Gould A. Andrews, Marshall Brucer, and Warren Glaser (Oak Ridge Inst. of Nuclear Studies, Tenn.). Intern. J. Appl. Radiation Isotopes 2, 140-4(1957).

A procedure for the measurement of thyroid clearance during the first hour after I^{131} administration is described. The behavior of I^{131} in the extrathyroid tissues of the neck is considered and the effect of changing distribution is taken into account in the calculation of uptake of I^{131} by the thyroid. It is shown that the extrathyroid iodide space of distribution is approximately 1 liter at 2 min, 1.27 liter at 30 min, and 1.31 liter at 60 min after intravenous injection of I^{131}. About one third of this volume is intravascular and the rate of expansion of the iodide space of distribution is similar to the rate of expansion of the sodium ion space of distribution. Equations that make a correction for this changing neck background are derived and the calculation of thyroid plasma iodide clearance is illustrated. (auth)

13256

EFFECT OF SPECIFIC ACTIVITY ON DISTRIBUTION OF RADIOLUTECIUM (Lu^{177}). William M. Christopherson, Granvil C. Kyker, H. F. Berg, and Marshall Brucer (Univ. of Louisville School of Medicine, Ky. and Oak Ridge Inst. of Nuclear Studies, Tenn.). Proc. Soc. Exptl. Biol. Med. 95, 750-4(1957) Aug.-Sept.

CHEMISTRY

13257 AERE-R/M-125

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

BORON FILMS. D. Barnes, R. B. MacKenzie, and R. Aves. June 1957. 8p.

This paper contains a brief discussion of a method of depositing boron films by simple evaporation, using electron bombardment as a means of heating the boron. Spectral transmission curves are given for chemically pure films and are compared with curves for contaminated films. (auth)

13258 AEC-tr-2943

DIELECTRIC CONSTANTS OF COLLOIDAL SYSTEMS. Erich Heyman. Translated from Kolloid-Z. 66, 229-35 (1939). 16p.

13259 AEC-tr-3037

INFORMATION ON MAGNESIUM ALUMINUM HYDRIDE $Mg(AlH_4)_2$. Egon Wiberg and Richard Bauer. Translated from Z. Naturforsch. 7b, 131-2(1952). 5p.

The hydrogenation properties were compared for $Mg(AlH_4)_2$ and $LiAlH_4$ and it has been found that the hydrogenation properties of $Mg(AlH_4)_2$ are equivalent to the $LiAlH_4$ and it can be effectively used in place of the latter. (R.V.J.)

13260

HYDROGEN EXCHANGE AND ISOTOPE EFFECT ON THE VINYLATION OF ACETIC ACID. Noboru Yamada (Toyama Univ.). Bull. Chem. Soc. Japan 30, 263-7(1957) Apr.

The mechanism of vinylation reaction of acetic acid was studied by the use of deuterium. The exchange of deuterium was found to occur between acetylene and acetic acid-d on zinc acetate-charcoal catalyst. The deuterium isotope effect of the reaction rate was also found, and the rate ratio, k_D/k_H, was 1.6 at 160°C. A mechanism of the reaction which contains a pre-equilibrium of intermediate ion formation, $CH \equiv CH + H \rightleftarrows CH_2 = CH$, $CH_2 = CH + CH_3COO^- \rightarrow CH_2 = CH \cdot OCOCH_3$, was proposed and discussed. (auth)

13261

A NEW METHOD FOR PREPARATION OF RADIOACTIVE COLLOIDAL GOLD. R. Henry, C. Herczeg, and C. Fisher. Intern. J. Appl. Radiation Isotopes 2, 136-9(1957). (In French)

A method for preparation of radioactive colloidal gold has been studied in order to get a uniform distribution of the particle size. The two steps of precipitation and growth of the particles are kept separate by using gold from chlorauric acid for reduction and precipitation. The average size of particles is 300 Å. (auth)

13262

CHEMICAL EFFECTS OF PLASTIC DEFORMATION AT HIGH PRESSURE. H. A. Larsen and H. G. Drickamer (Univ. of Illinois, Urbana). J. Phys. Chem. 61, 1249-52 (1957) Sept.

During plastic deformation at pressures from 3000 to 50,000 atm. solid potassium hexacyanoferrate(III) is rapidly converted to potassium hexacyanoferrate(II) and other products. Pressure alone without plastic deformation causes no appreciable reaction in this system. Although the same reaction can be induced thermally the mechanism of the conversion during shear at high pressure does not involve bulk heating or localized heating in any important way. Two possible mechanisms for the specific influence of lattice distortion are postulated. Extreme distortion near an anion could cause it to release electrons directly to neighboring anions thus reducing the size of the donor anion and alleviating the distortion. Alternately, regions having abnormally high concentrations of potassium ions could act as temporary trapping sites for electrons thus facilitating their transfer from one anion to another. (auth)

AEROSOLS

13263 AERE-C/M-319

Gt. Brit, Atomic Energy Research Establishment, Harwell, Berks, England.

A SMALL SCALE CYCLONE MICRONIZER. J. D. M. McConnell. June 1957. 5p.

A small scale apparatus for the reduction of the particle size of powders is described. Details are given of the construction, operation, and performance. (auth)

13264 HW-46722

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

ELECTRON MICROSCOPY OF MAGNESIUM OXIDE PARTICLES COLLECTED ON MEMBRANE FILTERS. R. Borasky and B. Mastel. Jan. 1956. 13p. Contract W-31-109-Eng-52. $0.50(OTS).

Magnesium oxide smoke was collected on Formvar coated electron microscope specimen screens and on membrane filters. The membrane filters were processed for electron microscopy by a modified Kalmus transfer technique and by replicating with graphite. Electron micrographs were analyzed for particle population, size distribution, and aggregation characteristics. There is a decrease in the number of particles and concurrent breakdown of aggregate particles during processing. (auth)

ANALYTICAL PROCEDURES

13265 AERE-C/R-2137

United Kingdom Atomic Energy Authority. Research Group. [Chemistry Div.], Woolwich Outstation, England.

THE SPECTROCHEMICAL DETERMINATION OF LITHIUM IN CORNISH CHINA CLAY. E. H. Henderson, M. J. Owers, and M. S. W. Webb. Apr. 1957. 15p.

Experimental work in connection with the flotation of Li-bearing micas from waste dumps of Cornish china clay necessitated the determination of Li in micacious and silicious materials over the range 0.05 to 0.4% with a precision of ± 5% of the Li content. Two possible methods of approach were examined and both gave satisfactory results. One method involved dilution of the sample with a suitable spectrographic buffer and internal standard followed by excitation in a d.c. arc. The alternative method utilized flame photometry after preliminary solution of the sample in mixed acids. (auth)

13266 CRDC-704

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

THE DETERMINATION OF TRACE QUANTITIES OF URANIUM IN NRU ALUMINUM SHEATHING BY NEUTRON ACTIVATION ANALYSIS. W. D. Mackintosh and R. E. Jervis. Apr. 1957. 25p. (AECL-481).

Two neutron activation methods for determining submicrogram quantities of uranium in aluminum are described. One method utilizes the neutron capture reaction of U^{238} on irradiation in a nuclear reactor, the other utilizes the fission of U^{235}. The results obtained for a variety of samples are given as well as an estimate of the precision and accuracy of the methods. A knowledge of the uranium content of the aluminum used for sheathing NRU fuel elements permits the choice of a suitable background level for monitoring the completed fuel elements for surface contamination. The amount of fission product activity likely to be discharged into the moderator or coolant of a nuclear reactor can also be calculated. (auth)

13267 KAPL-M-ELS-7

Knolls Atomic Power Lab., Schenectady, N. Y.

THE DETERMINATION OF IRON IN OPTICAL GRADE ZINC BROMIDE. E. L. Shirley and L. K. Lolos. Sept. 1957. 6p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

Iron in 80 wt. % ZnB_2 solution was determined colorimetrically after a preliminary separation from the Zn. The Fe separation from Zn is based on the solubility of $Zn(OH)_2$ in a solution containing excess NH_4OH. (auth)

13268 UCRL-4918

California. Univ., Livermore. Radiation Lab.

DETERMINATION OF LITHIUM CARBONATE IN LITHIUM HYDRIDE. Jack W. Frazer and Carl W. Schoenfelder. Mar. 12, 1957. 7p. Contract W-7405-eng-48. $0.50 (OTS).

A capillary trap method was developed for the determination of Li_2CO_3 in LiH. The sample is hydrolyzed in constant boiling HCl and the evolved CO_2 measured as a gas. An accuracy of ±0.01% by weight is obtained. (auth)

13269

THE DETERMINATION OF TIN IN ZIRCONIUM AND ITS ALLOYS. D. F. Wood and R. T. Clark (Imperial Chemical Industries, Witton, Birmingham, Eng.). Analyst 82, 624-30(1957) Sept.

A volumetric method is described for the determination of Sn in Zr and its alloys. The procedure is based on the direct reduction of Sn with Al in the presence of titanous ions and subsequent oxidation of tin with a standard solution of KIO_3. The method is accurate over the range 0.01 to 20% of Sn, is rapid and can be extended to the examination of samples containing larger amounts of this metal. No significant error is introduced by the presence of Fe or Ni up to at least 20%, W up to 10%, and Cu, Mo, or V up to 5%. Below 2% of Sn, up to 0.5% of Cr has no effect, but, in the determination of larger amounts of Sn, Cr can only be tolerated up to about 0.25%. Modifications to the direct procedure are described whereby interference from larger amounts of Cr can be overcome. The standard deviation is 0.015 at the 2% of Sn level. (auth)

13270

FLUOROMETRIC URANIUM ANALYZER. J. T. Byrne (Dow Chemical Co., Denver, Colo.). Anal. Chem. 29, 1408-12(1957) Oct.

A fluorometric uranium analyzer has been constructed which, although simple in design, gives measurements that are virtually insensitive to line voltage variations of ±15 volts and to three-fold changes in lamp intensity. An RCA 5819 photomultiplier tube detects the fluorescent light from the uranium–sodium fluoride phosphor, and a second 5819 tube monitors the incident ultraviolet light. The output of the second photomultiplier is fed to a series regulator tube, which adjusts the voltage (and sensitivity) of both photomultipliers to compensate for variations in lamp intensity and line voltage. (auth)

13271

SPECTROPHOTOMETRIC DETERMINATION OF RUTHENIUM WITH 1,10-PHENANTHROLINE. Charles V. Banks and Jerome W. O'Laughlin (Iowa State Coll., Ames). Anal. Chem. 29, 1412-17(1957) Oct.

A new spectrophotometric method for the determination of Ru is based on the reaction of Ru(III) or Ru(IV) with 1,10-phenanthroline in the presence of a reducing agent to form the very stable and intensely colored tris(1,10-phenanthroline)ruthenium(II) ion. The method is sensitive and accurate. As little as 0.1 part of Ru per million parts of solution can be quantitatively determined. A method for the rapid separation of trace amounts of Ru from most other metals based on the distillation of RuO_4 is described. For the distillation a mixture of sulfuric and perchloric acids is employed as the oxidizing agent and the RuO_4 evolved is quantitatively absorbed in a dilute HCl solution containing hydroxylammonium chloride. A simple and easily constructed distillation apparatus is used. (auth)

13272

COULOMETRIC DETERMINATION OF PLUTONIUM. William N. Carson, Jr., Jeanette W. Vanderwater, and Herman S. Gile (General Electric Co., Richland, Wash.). Anal. Chem. 29, 1417-22(1957) Oct.

A general chemical method for the determination of small amounts of Pu in solution consists of a coulometric titration based on the preliminary oxidation of the Pu(VI), followed by titration with electrolytically generated ferrous ion to Pu(IV). It is subject to few interferences. It can be used for samples containing 3 γ to 10 mg of Pu. The precision expressed as the standard deviation of a single result is within about 5% at the 3-γ level and 1% at the 1-mg level. Both manual and automatic procedures were found suitable for the entire range of sample size. Simple modifications overcome the few interferences. Thus amounts of Pu heretofore determined only by radioassay methods can be determined chemically, and larger amounts are more readily determined and with higher precision than with previous methods. The work extends the application of coulometric titration methods to a new substance. (auth)

13273

COLOR REACTION BETWEEN THORIUM AND QUERCETIN AND SEPARATION SCHEME FOR INTERFERING IONS. Oscar Menis, D. L. Manning, and Gerald Goldstein (Oak Ridge National Lab., Tenn.). Anal. Chem. 29, 1426-30 (1957) Oct.

The color reaction between Th and quercetin is the basis of a precise method for the spectrophotometric determination of Th. The yellow complex exhibits maximum absorption from 420 to 425 mμ when measured against a reagent blank. The absorbance of the complex at 422 mμ is constant in solutions ranging from a pH of 2.7 to 3.5, and adheres to Beer's law over a range of 10 to 150 γ of Th in a 25-ml volume. The ratio of quercetin to Th in the complex is 2 to 1, while the dissociation constant is calculated to be approximately 1.2×10^{-10}. Major interferences are discussed. The separation of Th from interfering substances is effectively accomplished by a combination of ion exchange separation and thenoyltrifluoroacetone extraction. (auth)

13274

SEPARATION AND DETERMINATION OF TANTALUM. Glenn R. Waterbury and Clark E. Bricker (Los Alamos Scientific Lab., N. Mex.). Anal. Chem. 29, 1474-9(1957) Oct.

Between 0.025 and 3.00 mg of tantalum are extracted into hexone (4-methyl-2-pentanone) from 6M sulfuric acid–0.4M hydrofluoric acid media and estimated colorimetrically using hydroquinone in concentrated sulfuric acid. Tantalum found averaged 100.2%, with a standard deviation of 1.3%, in 50 analyses of known solutions containing 0.5 to 3.39 mg of tantalum and various amounts of other elements. No interference in determination of 1 mg of tantalum was caused by 100 mg of sodium, potassium, uranium, and plutonium, 20 to 40 mg of aluminum, chromium(III), strontium, vanadium(V), thallium(I), cobalt, and iron(III), and 2 to 3 mg of tungsten, neodymium, cerium, zirconium, ruthenium(IV), and gold. Interference of titanium and molybdenum may be eliminated by double extraction. Niobium is the only metal that interferes seriously. (auth)

13275

METHOD FOR ROUTINE DETERMINATION OF SULFUR-35 IN BIOLOGICAL MATERIAL. Sidney S. Walkenstein and Cornelius M. Knebel (Wyeth Inst. for Medical Research, Radnor, Penna.). Anal. Chem. 29, 1516-17(1957) Oct.

A procedure for determining S^{35} in biological samples was developed for use in a study on the physiological disposition of S-tagged drugs. The entire analysis, from the oxidation of the organic S to the drying of the $BaSO_4$ precipitate, is performed in a tared centrifuge tube modified to facilitate packing and washing of the precipitate. The results are comparable in reproducibility to those obtained with filtration. The $BaSO_4$ is easily transferred to a planchet for counting. This method, applicable to the simultaneous analysis of large numbers of samples, avoids the danger, inherent in the use of sintered-glass filters, of radioactive contamination of successive samples. (auth)

13276

ULTRAVIOLET SPECTROPHOTOMETRIC DETERMINATION OF CERIUM(III). H. L. Greenhaus, A. M. Feibush, and Louis Gordon (Syracuse Univ., N. Y.). Anal. Chem. 29, 1531-4(1957) Oct.

Cerium(III) can be determined by measurement of its ultraviolet absorption peak at 253.6 mμ in 1N H_2SO. Beer's law is obeyed from 0 to 400 mg of Ce per liter. The interference effects of ten rare earths and several other ions have been studied. The method is rapid and precise and does not have some of the instability problems associated with solutions containing Ce(IV). (auth)

13277

RADIOMETRIC TITRATION OF RARE ELEMENTS. DETERMINATION OF BERYLLIUM, ZIRCONIUM AND THALLIUM. I. P. Alimarin, I. M. Gibalo, and I. A. Sirotina (Moscow State Univ. and Academy of Sciences of the U.S.S.R.). Intern. J. Appl. Radiation Isotopes 2, 117-28 (1957).

The paper contains experimental data on the volumetric determination of Be, Zr, and Tl by a radiometric titration method. In titration of Be and Zr, diammonium phosphate and phosphoric acid were used as the reagent. Titration of Tl was carried out with potassium iodide, potassium chromate, phosphotungstic acid and sodium tetraphenylboron. New volumetric techniques were developed for determining Be, Zr, and Tl in industrially important products. The composition of precipitates formed was studied. It was shown that it is possible to determine the equivalence point by calculation from two known points of the radiometric titration curve. (auth)

FLUORINE AND FLUORINE COMPOUNDS

13278

INVESTIGATIONS OF THE HYDROGEN EXCHANGE REACTIONS WITH LIQUID HYDROGEN FLUORIDE. Ya. M. Varshavskii, M. G. Lozhkina, and A. I. Shatenshtein (Karpov Physico-Chemical Inst., Moscow). Zhur. Fiz. Khim. 31, 1377-86(1957) June. (In Russian)

The hydrogen exchange reactions with liquid hydrogen fluoride and aromatic as well as alicyclic hydrocarbons were studied to determine the effects of solvent dielectric constant on the rate of exchange. The catalytic action of BF_3 on the exchange reaction has been shown. (tr-auth)

GRAPHITE

13279 AERE-CE/M-126

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

GRAPHITE AS CONTAINER MATERIAL FOR FUSED SALTS AND METALS COMPARISON OF SOME COMMERCIAL SPECIMENS. T. Beirne and J. M. Hutcheon. Apr. 4, 1955. 7p.

The use of graphite as a containing material for fused salts and liquid metals in reactors and high-temperature chemical separation processes is discussed. The relevant properties of available graphites and possible manufacturing methods were studied. (W.L.H.)

13280

THE SPECTROGRAPHIC DETERMINATION OF BORON IN GRAPHITE. F. W. J. Garton (U. K. Atomic Energy Authority, Royal Arsenal, London). Spectrochim. Acta 9, 297-306(1957).

The development of a sensitive arc method for the routine determination of boron in graphite over the range 0.2 to 1.5 ppm is described. The sample in the form of powder is compressed into pellets with the aid of a phenol–formaldehyde resin as binding medium, and these are arced in graphite holders at 7 a (d-c). The density of the BI 2497.73 is compared with that of the NO(γ) band component at 2497.14. The effects of possible disturbing factors are considered, and the extension of the method, by means of cathode-ray microphotometry, down to a lower limit of 0.01 ppm boron, is described. The method can be applied to coke and pitch with suitable modifications. (auth)

LABORATORIES AND EQUIPMENT

13281

TWO-PIECE CENTRIFUGE CRUCIBLE FOR HANDLING MICROCHEMICAL PRECIPITATES. Cyrus Feldman and Janus Y. Ellenburg (Oak Ridge National Lab., Tenn.). Anal. Chem. 29, 1557(1957) Oct.

Equipment is designed to make possible the processing of microchemical precipitates without changing containers, thereby reducing or eliminating contamination. (auth)

RADIATION CHEMISTRY

13282 USNRDL-TR-163

Naval Radiological Defense Lab., San Francisco.

TRI-DIMENSIONAL EXAMINATION OF CHEMICAL SYSTEMS IN GEL MEDIA. L. H. Gevantman, R. C. Chandler, and J. F. Pestaner. May 29, 1957. 32p. Project NS 081-001.

The present study describes a technique for the colorimetric measurement of tri-dimensional reaction product distributions in firm aqueous gels. Two chemical systems are employed. These systems contain agar (1 per cent by weight) in combination with low concentrations of either KI-starch or trichloroethylene-bromcresol purple. The change in the KI system, colorless to deep blue, results from the radiation-induced oxidation of I^- to I_2. The change in the trichloroethylene-bromcresol purple system, purple to yellow, is caused by the production of HCl. The gels are irradiated in square tubes with x rays from a Van de Graaff accelerator and a 250-KVP x-ray machine. After irradiation they are sliced and examined in detail. The color distribution throughout the reaction zone is measured photometrically with a recording microphotometer. Dep[th]-dose plots for the two systems are shown. (auth)

RADIATION EFFECTS

13283 HARD(B)/P-24

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

PRELIMINARY INVESTIGATIONS ON THE PROPERTIES OF THORIA SLURRIES UNDER IRRADIATION. J. K. Dawson, K. Alcock, D. R. Chilton, and T. Johnston. Nov. 27, 1956. 17p. (HARD(C)/P-22).

Thoria slurries were irradiated in static autoclaves in BEPO to an integrated neutron flux of $\sim 1.5 \times 10^{18}$ neutron/cm^2, and some of their properties were compared with similar experiments out of irradiation. There was usually a decrease in surface area of the thoria, but this appeared to be no greater than that obtained out of pile. Most of the in-pile experiments showed a decrease in pH and this was attributed to production of HNO_3 in the gas phase from the air which remained in the autoclaves after sealing. Under some conditions the thoria was found to contain ~1000 ppm of Fe after irradiation, and occasional high Cr figures were observed also. The short-term corrosion rate of the stainless steel autoclaves was ~1 mil/year, but this might decrease considerably with time. There was also limited evidence that at 330°C irradiation increases the corrosion rate by a factor of 2 to 3. Experience was gained in the design and use of high-pressure equipment for pile irradiation, which has now been extended to include the uranyl sulfate investigations. (auth)

13284 WADC-TR-57-141

Stanford Research Inst., Menlo Park, Calif.

A COMPARISON OF HIGH-ENERGY ELECTRON AND GAMMA IRRADIATION EFFECTS ON ORGANIC LIQUIDS. [Period covered] May 1, 1956 to February 21, 1957. Edwin L. Zebroski and Edwin M. Kinderman. Feb. 21, 1957. 21p. Project title: MATERIALS ANALYSIS AND EVALUATION TECHNIQUES. Task title: EFFECTS OF NUCLEAR RADIATION. Contract AF33(616)-3738. (AD-130857).

It has been proposed that high-energy electron irradiation be substituted for gamma irradiation in testing the radiation resistance of aircraft materials, components, and systems. To determine the feasibility of the proposal, the effects of electron and gamma radiation on selected organic liquids were compared. Results of this study and the experimental work reported by others indicate that there is qualitative similarity between electron and gamma radiation effects on simple compounds. Some differences in quantitative yields are observed, but these may be a result of differences in time of irradiation rather than of differences in radiation type. (auth)

13285

A THEORY OF NETWORK FORMATION IN IRRADIATED POLYESTERS. A. Charlesby (T. I. Research Labs., Cambridge). Proc. Roy. Soc. (London) A241, 495-507(1957) Sept. 10.

Many polyester systems may be converted to insoluble materials when subjected to high-energy radiation. The radiation doses required are far lower than would be predicted on the theory of random cross-linking, indicating that the process involved is a chain reaction, acting through double bonds. Present theories of network formation are not applicable to such reactions. A mathematical analysis is given, applicable to a chain reaction the extent of which is limited by an inhibiting factor. The gel point and the

solubility are deduced as functions of the cross-linking index and the inhibitor activity, for molecules of various sizes and distributions. These results are then related to the radiation dose. The model proposed may be applicable to chain reacting systems in which the reaction is not terminated by the interaction of two growing chains. (auth)

RARE EARTHS AND RARE-EARTH COMPOUNDS

13286

THE CRYSTAL STRUCTURE OF YTTRIUM NITRIDE. Charles P. Kempter, N. H. Krikorian, and Joseph C. McGuire (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem. 61, 1237-8(1957) Sept.

Yttrium nitride was prepared by converting Y metal to YH_2 and then to YN. The polycrystalline YN was examined by x-ray diffraction, using both photographic and diffractometric methods. Yttrium nitride has space group O_h^5-Fm3m (NaCl structure-type) and 4 (YN) per unit cell. The lattice constant is 4.877 ± 0.006 A at 23°C and the calculated density is 5.89 ± 0.02 g/cm^3 at 23°C; the pycnometric density was found to be 5.60 ± 0.05 g/cm^3 at 20°C. The melting point of YN is ≥ 2670°C in the presence of one atmosphere of N_2. (auth)

13287

THE SPECTROGRAPHIC DETERMINATION OF THE RARE EARTHS. J. R. Butler (Imperial Coll. of Science and Tech., London). Spectrochim. Acta 9, 332-40(1957).

A d-c arc method is described for estimating the rare earths in rare earth oxides separated from minerals. The spectrograph used is a specially constructed glass Littrow prism type with a dispersion of 2.7 A/mm at 4000 A; this is adequate for the determination of 15 of the 16 naturally occurring rare earths in oxides poor in Ce and 13 of the rare earths in oxides rich in Ce. The method and lines selected will be of varying use to other workers interested in the geochemistry of the rare earths depending on the spectrograph available. (auth)

SEPARATION PROCEDURES

13288 AERE-C/M-148

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

INVESTIGATIONS RELATING TO A POSSIBLE CHLORIDE PROCESS FOR THE SEPARATION OF URANIUM, PLUTONIUM AND FISSION PRODUCTS. J. K. Dawson, A. E. Truswell, and A. R. Gibson. May 1, 1952. Decl. July 2, 1957. 8p.

The dissolution of irradiated uranium metal in molten lead chloride has been investigated as a means of separating uranium and plutonium from fission products. The possibility of a complete dry-chloride separation using precipitation of a uranium-aluminium alloy as a second stage has also been examined but shown to be unreliable on a small scale. The dissolution in lead chloride could be followed by solvent extraction separation of uranium and plutonium from an aqueous solution of the melt, however, and this might lead to a smaller plant than the present one. (auth)

13289 AERE-C/R-2260

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

NITRATO NITROSYLRUTHENIUM COMPLEXES AND THEIR EXTRACTION FROM NITRIC ACID SYSTEMS BY TRIBUTYL PHOSPHATE. PART I. LABORATORY STUDIES. P. G. M. Brown, J. M. Fletcher, and A. G. Wain. May 1957. 61p.

A separation of the individual nitrato nitrosylruthenium complexes which exist in HNO_3 solutions has been achieved by paper chromatography, and the technique has also been applied to solutions of the complexes in TBP–HNO_3–H_2O systems. It has been possible to determine the equilibrium compositions of solutions of these complexes, the partition coefficients, with TBP, of the individual complexes under certain specified conditions, and the rates of the reactions by which there is interchange between the complexes. This knowledge has been used to interpret the over-all Ru distribution coefficients which are obtained when solutions of these complexes, under a wide variety of concentrations of HNO_3 and of TBP, are intimately mixed. The conditions investigated are related to acid systems for the extraction by TBP of fissile material from HNO_3 solutions of irradiated fuels: in such solutions, fission product Ru can occur, to a greater or lesser extent, as these nitrato (RuNO) complexes. (auth)

13290 DOW-161

Dow Chemical Co. Western Div., Pittsburg, Calif.

RECOVERY OF VANADIUM FROM COLORADO PLATEAU ORES BY SOLVENT EXTRACTION. David A. Ellis. Sept. 1, 1957. 50p. Contract AT-30-1-GEN-236. $1.50(OTS)

The laboratory development of a process for the recovery of V from H_2SO_4 leaches of Colorado Plateau ores by solvent extraction with alkyl phosphoric acids is presented. Bench-scale studies of the variables involved in the extraction, stripping, and product precipitation steps and continuous countercurrent extraction studies in a laboratory, multistage, mixer-settler unit are described. (auth)

13291 HW-48873

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

CRITICALITY CONSIDERATIONS IN FINAL CYCLE PROCESSING OF ENRICHED URANIUM FUELS. Norman Ketzlach. Mar. 5, 1957. 6p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

Data is presented to help evaluate the presence or absence of criticality problems in final cycle processing of slightly enriched uranium fuels irradiated in a graphite pile. The possible presence of criticality problems in the shipping of UO_3 in drums, although no such problems may exist in the processing plant, have also been indicated. (auth)

13292 NAA-SR-2047

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

REMOVAL OF FISSION PRODUCTS FROM MOLTEN THORIUM–URANIUM ALLOY RESULTING FROM GRAVITY FLOW THROUGH FROZEN CALCIUM FLUORIDE BEDS. A. G. Buyers, J. Chilton, and W. E. McKee. Oct. 1, 1957. 17p. Contract AT-11-1-GEN-8. $0.20(OTS).

Thorium–uranium (10 wt. %) alloy samples have been partially decontaminated using a salt-bed process. The method consists of induction melting the alloy supported by a vertical column of compacted CaF_2. The molten metal then melts its salt environment and, under gravity, passes down through the salt column. Experiments in which melting periods of from 3 to 28 minutes for the irradiated metal, and CaF_2 columns of from 1 to 6⅛ inches in length were used have disclosed removal of 35 to 98% Ce, Sr, rare earths, and Cs. Seventy to eighty % of the Te was removed. Thorium losses amounted to 1 to 12%. Zirconium, Ru, Pa, and U were not appreciably extracted by the salt bed. It is suggested that this salt–metal system does not reach equilibrium with regard to fission product and fissionable element distribution. Experimental results have been empirically correlated by the IBM 704 computer. Other applications of salt-bed processing are indicated.

These include fundamental studies requiring pure systems, recovery of valuable materials such as Pu, metal purification, and the use of refractory columns in drossing research. (auth)

13293 WIN-21

National Lead Co., Inc. Raw Materials Development Lab., Winchester, Mass.

ELECTROLYTIC STUDIES IN CARBONATE SOLUTIONS. A. R. Kazanjian. Apr. 4, 1956. Changed from OFFICIAL USE ONLY Sept. 5, 1957. 24p. Contract AT(49-6)-924. $4.80(ph OTS); $2.70(mf OTS).

The electrolytic reduction and precipitation of uranium from carbonate leach solutions was investigated. Electrolytic reduction of uranium in a mercury cathode cell followed by precipitation with sodium hydroxide was also studied. (auth)

13294

SEPARATION OF NIOBIUM FROM TANTALUM, TITANIUM TIN AND ANTIMONY BY MEANS OF 8-HYDROXYQUINOLINE. G. K. Belekar and V. T. Athavale (Atomic Energy Establishment, Bombay, India). Analyst 82, 630-4 (1957) Sept.

From solutions of earth acids in tartrate medium and adjusted to pH 6.0, Nb can be quantitatively precipitated by means of 8-hydroxyquinoline. From the filtrate, Ta can be recovered by means of tannic acid. Titanium, when present together with earth acids, is distributed in the two fractions, the major amount remaining with the Ta. Each fraction is corrected for Ti after determining it by the peroxide method. For oxides obtained by a direct ethylenediaminetetra-acetic acid–tannic acid procedure and containing Sn and Sb oxides, the same procedure for the separation of Nb in the tartrate medium is followed. However, before the recovery of Ta by tannic acid, Sn and Sb in the filtrate after treatment with 8-hydroxyquinoline are removed by precipitation as sulphides with hydrogen sulfide. (auth)

13295

ON THE DISTRIBUTION AND BEHAVIOR OF WATER IN CATION-EXCHANGE RESIN MEMBRANES. Yoshio Oda and Tadashi Yawataya (Research Lab. of Asahi Glass Co., Yokohama). Bull. Chem. Soc. Japan 30, 213-18(1957) Apr.

It was assumed for a mechanism of electro-osmosis through ion-exchange resin membranes that the primary shell hydration water of mobile ions transfers with the same mobility as the ions, and the solvent water within the resin phase is dragged by the migrating cations or anions toward anode or cathode, the net result being observed as electro-osmosis. On this view, the mobilities of solvent water relative to those of cations were calculated from the measurements of electro-osmotic properties of cation exchange resin membranes equilibrated with varied concentration of LiCl, NaCl, KCl, NH_4Cl, CsCl, and HCl solution. In addition, from these experimental data the amount of hydration of the fixed sulfonate ion was estimated as 1.5 to 3.5 moles per equivalent. (auth)

13296

THE PURIFICATION OF PLUTONIUM BY A THENOYLTRIFLUOROACETONE (T.T.A.) PROCESS. J. G. Cuninghame (Argonne National Lab., Lemont, Ill.) and G. L. Miles (Australian Atomic Energy Commission). J. Appl. Chem. (London) 7, 72-81(1957) Feb.

The extraction of plutonium by thenoyltrifluoroacetone in the presence of impurities is discussed, and data are presented for the extraction of U, Zr, Ru, Fe, and Cr. A block flowsheet for the purification of 1 g of Pu from 10 g of U and one curie of Zr is given. (auth)

13297

ON THE STUDY OF THE USE OF CALCIUM OXALATE MONOHYDRATE IN THE INVESTIGATION OF RARE EARTH AND THORIUM ACTIVITIES. B. C. Purkayastha and S. N. Bhattacharyya (Inst. of Nuclear Physics, Calcutta, India). J. Indian Chem. Soc. 34, 427-33(1957) June.

The use of CaC_2O_4 as carrier for rare earths and Th is discussed. It has been used to prepare carrier-free Th^{234} from aged $UO_2(NO_3)_2$ and is convenient for determining counter geometry factor. Experiments are described where ratios of rare earths to impurities such as U, Th, Zr, Be, and Al up to 1 to 10^8 were obtained. (T.R.H.)

SPECTROSCOPY

13298 AERE-GP/R-2279

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

THE APPLICATION OF "END-ON INPUT" ELECTRON-MULTIPLIERS TO ION-BEAM DETECTION IN THE MASS SPECTROMETER. D. B. McCulloch. May 1957. 28p.

Some constructional details are given for two types of electron-multiplier, and their characteristics investigated with particular reference to their application to mass spectrometry. (auth)

13299 IGR-TN/CA-484

Gt. Brit. Capenhurst Works, Capenhurst, Ches., England.

CAPABILITIES OF THE HIGH-RESOLUTION NUCLEAR MAGNETIC RESONANCE SPECTROMETER AT R. AND D. B., CAPENHURST. P. G. Bentley and A. N. Hamer. Aug. 1957. 18p.

The general principles of nuclear magnetic resonance are discussed, and an account is given of the increased amount of information which becomes available under conditions of very high resolution. A brief description of the Varian nuclear magnetic resonance spectrometer No. 4300 now at Capenhurst, together with some details of its performance since installation, is included. A selection of chemical problems which have been investigated by nuclear magnetic resonance spectroscopy to illustrate some of the more promising applications of the technique is discussed. This discussion is amplified by a description of some problems already being investigated at Capenhurst. (auth)

13300 AEC-tr-3039

USE OF THE METHOD OF ADMIXTURES IN SPECTRAL ANALYSIS. E. N. Vinichenko, A. N. Zaidel, and N. I. Kaliteevskii (Kaliteevsky). Translated from Vestnik Leningrad. Univ. 11, 119-25(1954). 10p.

Procedures in spectral analysis of $LaCl_3$ solution with YCl_3 as standard are described. The error of the spectral determination was checked by repeated measurements, and calibration of curves using three standard concentrations in the interval $\sim 10^{-2}$ to 10^{-3}% La were investigated. The blackening of the lines used in analysis, for the whole concentration, lay within the range of the photographic plates. The average error was 3.0% determined from 150 photographs. (R.V.J.)

TRITIUM AND TRITIUM COMPOUNDS

13301

IN VIVO RADIOTRACER STABILITY OF A TRITIUM "SELF-RADIATION" -LABELED COMPOUND. James L. Spratt, George T. Okita, and E. M. K. Geiling (Univ. of Chicago). Intern. J. Appl. Radiation Isotopes 2, 167-8 (1957).

URANIUM AND URANIUM COMPOUNDS

13302 IGR-TN/R-551

United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs, England.

SOME SAFE METHODS FOR STORING AQUEOUS SOLU-

TIONS OF U^{235}. A. Campbell. July 1957. 8p.

In chemical plants concerned with the processing of fissile material it is frequently required to provide tanks for the safe storage of solutions. In addition to the safety factor the cost of fabrication and the physical size of such tanks must be considered. Some storage methods meeting these considerations are surveyed. The findings are applied to the storage of aqueous solutions of U^{235}. (auth)

13303

THE SELENIDES OF TETRAVALENT URANIUM. Parviz Khodadad. Compt. rend. 245, 934-6(1957) Sept. 2. (In French)

The selenide of tetravalent U, USe_2 occurs in three crystalline forms, α, β, and γ, analogous to the sulfide, US_2. These are obtained by the action of heat on USe_3. The lower temperature results in the γ product as already observed for the sulfides. (tr-auth)

13304

THE OXIDES OF URANIUM. PART VIII. THE SYSTEM URANIUM DIOXIDE-YTTRIA. I. F. Ferguson and P. G. T. Fogg (Atomic Energy Research Establishment, Harwell, Didcot, Berks). J. Chem. Soc. 3679-81(1957) Aug.

The mixed-oxide system $UO_2-Y_2O_3$ has been investigated by x-ray powder techniques. A range of solid solutions, with pseudo-fluorite structures, exists between 0 and 78 mole % of $YO_{1.5}$, whose cell constant is a non-linear function of composition. Between 78 and 96 mole % of $YO_{1.5}$ there is an immiscibility gap. Beyond 96 mole % of $YO_{1.5}$ a solid solution range occurs based upon the Tl_2O_3 structure. Density measurements show that all these solid solutions have an anion-vacancy structure. Samples were prepared and handled in vacuo, as they absorb oxygen at room temperature. (auth)

WASTE DISPOSAL

13305 AERE-CE/M-200

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

GRANULAR CLAY FOR ION EXCHANGE USE IN EFFLUENT DISPOSAL. J. R. Grover. Apr. 1957. 5p.

ENGINEERING

13306 WAPD-TM-56

Westinghouse Electric Corp. Bettis Plant, Pittsburgh.

A SIMPLE METHOD FOR CALCULATING THE MAXIMUM SIZE OF DUCTILE RUPTURE IN PRESSURIZED SYSTEMS. H. B. Ketchum. July 1957. 24p. Contract AT-11-1-GEN-14. $0.75(OTS).

A simple method is proposed for calculating the maximum size of ductile rupture in a pressurized system, should a failure of this type occur. Although brittle type fractures can also occur — and calculation of their maximum size is not feasible because of the rapidity and mechanics of brittle crack propagation — certain conditions must exist in a material to obtain a brittle-type fracture instead of the more usual ductile type. In view of this, the specification of certain conditions, e.g., pressurization at temperatures above the nil ductility temperature, can render a brittle-type fracture improbable, even when materials that are brittle-fracture sensitive below certain temperature levels are used in the fabrication of pressurized systems. Thus, with the exception of special situations which should be discovered during inspection, such as the occurrence of a long crack partially through the original material, the fracture resulting from crack propagation initiated by a small undiscoverable defect will be a ductile type fracture and one for which the proposed method of calculation applies. The method predicts a maximum and minimum length of actual rupture wherein gross parting of the metal occurs and/or a maximum length for cracks which usually precede actual rupture. (auth)

HEAT TRANSFER AND FLUID FLOW

13307 AERE-ED/M-11

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

A RELATION BETWEEN FRICTION FACTORS BASED ON TOTAL AND STATIC PRESSURES. D. V. Wordsworth. May 25, 1954. Decl. Nov. 14, 1956. 7p.

13308 IDO-28003

Aerojet General Corp., Azusa, Calif.

POLYPHENYL-COOLANT BURNOUT STUDIES. Monthly Progress Report No. 9 for July 16 through August 15, 1957. K. Sato. Sept. 10, 1957. 30p. Contract AT(04-3)-44. (AGC-L2917-9). $4.80(ph OTS); $2.70(mf OTS).

Polyphenyl compounds were tested to determine whether they are suitable for use as heat-transfer fluids in organic-moderated reactors. The maximum allowable heat flux to the fluid will be established experimentally by determining the heat-flux rate at the beginning of film boiling for various pressures, fluid velocities, and fluid temperatures. (W.L.H.)

13309 IGR-TN/W-500

Gt. Brit. Windscale Works, Sellafield, Cumb., England.

HEAT TRANSFER FROM A FLUID CONTAINING A DISTRIBUTED HEAT SOURCE. PROPOSALS FOR EXPERIMENTAL INVESTIGATION. D. Wilkie. May 1957. 22p.

To aid in the design of a liquid fuel reactor system a feasibility study has been made of methods of investigating the heat transfer process in fluids in which heat is being generated. The two cases of fluids contained in a long cylinder and a long rectangular vessel, both externally cooled, have been considered, as these have already received theoretical treatment and approximate to the closed pot type of reactor core. The report places resistance heating as the simplest and probably most feasible means of heat generation for the heat transfer experimental work, and recommends that the initial experiments should be with electrolytes and liquid metals, later being extended to include fluids that can be heated by dielectric and infra-red heating should the further study recommended of these methods prove them feasible. Methods of measurement of temperature and velocity distribution are also discussed. (auth)

13310 KAPL-M-RES-48

Knolls Atomic Power Lab., Schenectady, N. Y.

PLENUM FLOW DISTRIBUTION AND TIME CONSTANTS. H. F. Larkin. July 20, 1957. 26p. Contract W-31-109-Eng-52. $4.80(ph OTS); $2.70(mf OTS).

Methods of analyzing simple plenum geometries for flow distribution, vortices, and time constants are presented. Significant factors which affect vortices and time constants are pointed out to aid in plenum design. These are illustrated by use on specific examples from SAR which are compared with test data. Some precautions to consider when testing are pointed out. (auth)

13311 NURG/M-54

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

THE CHOICE OF STEAM CYCLE FOR USE WITH A PILE. O. Pulley. Mar. 12, 1953. 20p.

The work output theoretically obtainable from a fluid of constant specific heat, receiving heat over a given temperature range and rejecting it at a lower temperature, is reduced by imperfections in a practical engine. Combining this reduced output with fuel and capital costs which are believed to be attainable, it is found that an optimum temperature range exists for which the unit cost of available power is a minimum. With conditions applicable to a natural U, graphite moderated, gas cooled pile using Al fuel sheathing, the optimum coolant range is approximately from 280 to 610°F. A two pressure steam cycle with economizer designed for this coolant temperature range would generate roughly equal quantities of steam at 70 and 400 psia and give an over-all efficiency of 21%. The use of three pressures gives a small improvement; more than three pressures would not be profitable. Bled steam feed heating, although perhaps convenient, is not justified by the simple economics. (auth)

13312 AERE-Lib/Trans-695

SOME CHARACTERISTICS OF THE FLOW OF A TWO PHASE MIXTURE IN A HORIZONTAL PIPE. L. I. Krasiakova. Translated by P. Collins from Zhur. Tekh. Fiz. 22, 654-69(1952). 19p.

Experimental data obtained from the investigation of the regimes of flow of a two phase mixture in a horizontal pipe are presented. A description of the mechanism of flow in the basic regimes and their boundaries is given. The results of measurements of the transport of moisture and of the dynamic and total heads of the two phase mixture are presented. The results of measurement of the thicknesses of the liquid films in the two phase stream are given. (auth)

13313

HEAT TRANSFER IN FULLY DEVELOPED FLOW BETWEEN PARALLEL PLATES WITH VARIABLE HEAT SOURCES. Albert L. Loeffler, Jr. (Lewis Flight Propulsion Lab., Cleveland, Ohio). Nuclear Sci. and Eng. 2, 547-67(1957) Sept.

The analyses of Poppendiek and Palmer for laminar and turbulent flow between parallel plates with uniform internal heat generation have been extended to the case of internal heat generation decreasing parabolically with distance from the wall. It is shown that the effect of this nonuniformity is to increase the temperature of the wall with respect to the bulk temperature. Thus, the wall cooling required to maintain a given wall temperature is greater with the nonuniform than with the uniform internal heat generation. (auth)

MATERIALS TESTING

13314 KAPL-M-RFL-9

Knolls Atomic Power Lab., Schenectady, N. Y.

FABRICATION OF DEFECTIVE FUEL ELEMENTS AS STANDARDS FOR THE CALIBRATION OF NON-DESTRUCTIVE TEST EQUIPMENT. R. F. Lupi and C. M. Olds. July 5, 1957. 8p. Contract [W-31-109-Eng-52]. $3,30(ph OTS); $2.40(mf OTS).

Thirty-five fuel elements were fabricated through cold sizing by the reference process. These elements were purposely defected to simulate anticipated defects to be encountered in production. The elements contained such defects as tungsten and oxide inclusions in the fuel, seams, laps, folds, pits, unsized areas, and scratches in the cladding, and copper stringers in the cladding. The elements are to be used as standards for calibration of nondestructive testing and inspection equipment. The location of defects and methods of making the defects is described. (auth)

13315 NACA-TN-4009

Langley Aeronautical Lab., Langley Field, Va.

SOME RESEARCH RESULTS ON SANDWICH STRUCTURES. Melvin S. Anderson and Richard G. Updegraff. Mar. 6, 1957. 12p.

The results of compressive-buckling tests of steel sandwich plates are given, and the significant parameters which affect the strength of the plates are discussed. The various types of sandwich construction are shown to be comparable on a weight-strength basis with conventional high-strength Al-alloy construction. (auth)

PUMPS

13316 AERE-CE/M-184

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

A FUSED SALT PUMP AND 1 INCH TEST LOOP. F. Roberts and P. F. Wace. Nov. 26, 1956. 15p.

13317 AERE-GP/M-201

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

AN OIL-FREE PUMPING SYSTEM. A. H. Turnbull. June 1957. 5p.

A pumping system has been built in which a mercury diffusion pump is backed by a water jet pump. The latter is supplied by a centrifugal pump which circulates the water round a loop. It was found necessary to cool the water in the circulating system in order to reduce its vapor pressure to an acceptable value. (auth)

TRACER APPLICATIONS

13318

A RADIOACTIVE TRACER TECHNIQUE FOR THE STUDY OF TURBULENT DIFFUSION AND MIXING IN COAL-MINE VENTILATION. J. R. Hodkinson (Safety in Mines Research Establishment, Sheffield, Eng.). Intern. J. Appl. Radiation Isotopes 2, 97-104(1957).

Radioactive tracer methods are being used to study the turbulent diffusion and mixing that gases and respirable dusts (smaller than 5 microns) may be expected to experience in mine workings. The first studies relate to sampling airborne dust concentrations. A few millicuries of Br^{82} (as CH_3Br vapor) are released in a ventilated gallery, the air at twenty-five positions downstream is sampled through granulated charcoal collectors, and comparative concentrations are measured by γ-scintillation counter. The present accuracy is ±1.7% standard deviation. The results obtained, and the extension of the technique and its applications, are discussed. (auth)

13319

NEW TECHNIQUES FOR INVESTIGATING THE PROCESS OF DRYING. A. S. Shubin (Technological Food Inst., Moscow, U.S.S.R.). Intern. J. Appl. Radiation Isotopes 2, 110-16(1957).

An attempt has been made to use radioactive tracers for a study of the drying-process mechanism. Two methods have been suggested for experimental investigation of the phase transition of moisture in the process of drying—a stationary and a non-stationary method. The influence of various parameters on the value of the phase-transition criterion was established experimentally by means of the two methods. An equation has been deduced allowing to compute the intensity of internal evaporation in any layer of the material. (auth)

MINERALOGY, METALLURGY, AND CERAMICS

CERAMICS AND REFRACTORIES

13320
TWO TESTS ON THE ELECTROMECHANICAL BEHAVIOR OF BARIUM TITANATE CERAMIC IN THE CURIE ZONE. Günther Schmidt. Z. Physik 148, 314-20(1957). (In German)

The expansion of unpolarized barium titanate ceramic at room temperature as a function of polarization with superimposed alternating field is observed. (tr-auth)

CORROSION

13321 AERE-M/M-153
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
THE COMPATIBILITY OF SOME METALS WITH SANTOWAX. H. E. Davies. Mar. 1957. 12p.

The corrosive effects of Santowax R (78% mixed terphenyls, 22% higher polyphenyls) on U, Al, Zr, Be, Cu, brasses, bronzes, steels, UO_2, and UC_2 were studied. (T.R.H.)

13322 KAPL-M-GEG-10
Knolls Atomic Power Lab., Schenectady, N. Y.
RESULTS OF STRESS CORROSION CRACKING TESTS OF RETORT ANNEALED AND RESISTANCE ANNEALED T-347 STAINLESS STEEL TUBING. G. E. Galonian and H. L. Tymchyn. Aug. 26, 1957. 21p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

The results of chloride stress corrosion cracking tests of resistance annealed and retort annealed T-347 stainless steel steam generator tubing are given. These tests were made in a tilted autoclave exposing unstressed tube sections and stressed U-bend tubing to alternate wetting and drying with 500°F air-saturated boiler water. Nine resistance annealing treatments and one retort annealing treatment were investigated. Based on the number of cracks found and general corrosion resistance, tubing brought to resistance annealing temperature in $\frac{3}{4}$ to $1\frac{3}{4}$ min. appears to be as resistant to cracking as retort annealed tubes. Retort annealed tubes are more resistant to general corrosion than resistance annealed tubes. With the application of stress to resistance annealed tubing more resistance to cracking is obtained with heating times of $\frac{3}{4}$ to $1\frac{3}{4}$ min. than when shorter or longer times are used. Areas in the vicinity of electrical clamps on resistance annealed tubes are less resistant to corrosion and cracking than other sections of tubing. (auth)

13323 WAPD-127(Pt. II)
Westinghouse Electric Corp. Bettis Plant, Pittsburgh.
DEVELOPMENT AND PROPERTIES OF URANIUM-BASE ALLOYS CORROSION RESISTANT IN HIGH TEMPERATURE WATER. PART II. ALLOYS WITH PROTECTIVE CLADDING. I. Cohen, R. K. McGeary, W. A. Bostrom, and R. A. Wolfe—I. Cohen and E. F. Losco, eds. Sept. 7, 1955. Decl. Sept. 24, 1957. 159p. Contract AT-11-1-GEN-14. $4.00(OTS).

Several gamma phase U–Mo and U–Nb alloys and one epsilon phase U–Si alloy, which had been shown to have good corrosion resistance in high temperature H_2O and steam when tested in the bare condition, were selected for study of their corrosion behavior when clad with Zircaloy-2 by extrusion. Simulated rod-shaped fuel elements from the extrusions were used to investigate the corrosion resistance of the fuel alloy and the mechanism of failure as affected by the presence of the bonded cladding. Corrosion life tests were performed on these samples, and detailed results are given. An investigation was also made to determine the major factors responsible for variations in corrosion life and results indicate that these are pimpling of the cladding at the site of the defect caused by a localized build-up of oxide at the base of the defect, discontinuous cracking of the fuel in γ phase core alloys with subsequent rapid corrosion of the fuel and rupture of the cladding, and formation of corrodible core-clad interdiffusion layers. Heat treatment after extrusion and its effect on the corrosion was investigated. A study was also made of the interdiffusion of core and cladding. The effects of other variables, such as cold drawing, size of cladding defects, cladding thickness, and end plug design, on corrosion behavior were investigated. (W.L.H.)

13324
CORROSION AND METAL TRANSPORT IN FUSED SODIUM HYDROXIDE. PART 2. CORROSION OF NICKEL–MOLYBDENUM–IRON ALLOYS. G. Pedro Smith and Eugene E. Hoffman (Oak Ridge National Lab., Tenn.). Corrosion 13, 627t-30t(1957) Oct.

Studies were made of the corrosion by fused sodium hydroxide of nickel-rich alloys whose constituents were nickel, molybdenum, and iron exposed at 815°C for 100 hours. The reaction mechanism was found to involve the selective removal of iron and molybdenum from solid solution with nickel and a resultant formation of subsurface porosity. In most cases this porosity was shown to occur in the form of elongated pits which frequently followed tortuous paths and intersected to form a maze of subsurface channels. Alloys of nickel, molybdenum, and iron containing at least 70 percent nickel showed more resistance to corrosion by sodium hydroxide melts at 815°C than any other alloys which have been tested. (auth)

13325
HIGH ALLOYS TO COMBAT CORROSION. E. D. Weisert (Union Carbide Corp., Niagara Falls, N. Y.). Corrosion 13, 659t-71t(1957) Oct.

The use of highly alloyed materials to combat corrosion is discussed and extensive data are given. The following molybdenum-bearing alloys are considered at length: nickel-molybdenum alloy, nickel–molybdenum–chromium alloy, and nickel–chromium–iron–molybdenum alloy. Attention is given also to cobalt-base alloys and silicon-bearing alloys. Other matters considered in connection with these alloys include mechanical properties, welding characteristics, prewelding considerations, welding techniques, general fabrication considerations, and heat treatment. (auth)

13326
TITANIUM, ZIRCONIUM AND TANTALUM FOR CONTROL OF CORROSION. William E. Lusby, Jr. (E. I. DuPont de Nemours Co., Wilmington, Del.). Corrosion 13, 654t-8t (1957) Oct.

The corrosion resistant properties of Ta, Zr, and Ti are reviewed and progress in process applications presented. Fabricating knowhow and industrial experience have progressed to the point that these metals can be accepted as reliable materials of construction. Additional fundamental research is needed, however, to understand the mechanisms of attack and passivity noted. The use of these metals can now be economically justified in many locations. Volume production and lower prices forecast for Ti and Zr due to defense needs will lead to expanded use in corrosion resistant applications. (auth)

GEOLOGY AND MINERALOGY

13327 AEC-tr-3004

Argentina. Comisión Nacional de Energía Atómica, Buenos Aires.

GEOLOGIC, RADIOMETRIC AND BOTANICAL NOTES ON THE ZONE, "LOS CHANARES," PROVINCE OF MENDOZA, ARGENTINA. Translated by G. E. Denegar. [1957]. 8p.

A study was made of the areas which show values of naturally high radioactivity with respect to the zone of normal intensity in Argentina. (auth)

13328

DUTTONITE, A NEW QUADRIVALENT VANADIUM OXIDE FROM THE PEANUT MINE, MONTROSE COUNTY, COLORADO. M. E. Thompson, Carl H. Roach, and Robert Meyrowitz (U. S. Geological Survey, Washington). Am. Mineralogist 42, 455-60(1957) July-Aug.

Duttonite, a new quadrivalent vanadium oxide from the Peanut mine, Montrose County, Colo., has the formula $VO(OH)_2$. The mineral occurs as crusts and coatings of pale-brown transparent platy crystals, as one of the first oxidation products of montroseite ore. It is associated with melanovanadite and abundant crystals of hexagonal native selenium. Duttonite is biaxial positive, 2V is about 60°, dispersion is r < v, moderate; X = a, pale pinkish brown; Y = c, pale yellow-brown; Z = b, pale brown; $\alpha = 1.810 \pm 0.003$, $\beta = 1.900 \pm 0.003$, $\gamma > 2.01$. The hardness is about $2\frac{1}{2}$; the calculated specific gravity is 3.24. The chemical analysis shows, in per cent: V_2O_3 2.6, V_2O_4 75.3, FeO 0.4, H_2O 18.1, insoluble 4.2, total 100.6. Duttonite is monoclinic, $a_0 = 8.80 \pm 0.02$Å, $b_0 = 3.95 \pm 0.01$Å, $c_0 = 5.96 \pm 0.02$Å, $\beta = 90°40' \pm 5'$. The space group is I2/c, (C_{2h}^6); the cell contents are $4[VO(OH)_2]$. The crystals are strongly pseudo-orthorhombic, and the structure departs only slightly from the space group Imcm. Duttonite is named for Captain Clarence Edward Dutton (1841–1912), early member of the U. S. Geological Survey. (auth)

13329

THE PHOTOELECTRIC MEASUREMENT OF REFLECTIVITY. S. H. U. Bowie (Geological Survey of Great Britain). Mineral. Mag. 31, 476-86(1957) June.

A simple photoelectric-cell attachment for use with an ordinary ore-microscope is described. Stabilization of the light source and accurate calibration of the photometer enable reflectivity values to be determined within an accuracy of 1% of the measured value. The choice of a universally acceptable standard is discussed. The photometer can be used with white light or with light of different wave-lengths. Bireflection, dispersion, and dispersion of the bireflection can readily be measured. (auth)

13330

SELECTED ANNOTATED BIBLIOGRAPHY OF THE GEOLOGY OF URANIUM-BEARING PHOSPHORITES IN THE UNITED STATES. Diane Curtis. U. S. Geol. Survey Bull. 1059-B. 1957. 32p.

A bibliography listing nearly all reports pertaining to U in domestic phosphorites available to the public as of Dec. 1, 1955 is presented. (auth)

METALS AND METALLURGY

13331 AD-5114

North Carolina State Coll., Raleigh.

RESEARCH ON VIBRATORY COMPACTING OF METAL AND CERAMIC POWDERS. Quarterly Report No. 3 [for] October 20, 1952–January 20, 1953. William C. Bell. 16p. Project No. 52-670A-83. Contract AF33(616)-73.

Results obtained in the vibratory compaction of particle-sized mixtures of pure, fused alumina in a pneumatic vibrator machine are presented. High unfired densities were obtained by this method. Dusting of the sample from the mold box during the forming operation was eliminated and specimens with smooth surface textures were produced with the use of compositions containing as high as 60% of 14-mesh material. The preliminary findings on the use of superimposed vibrations of different frequencies are shown. Preliminary work was begun on the hydrostatic forming of these mixes for comparative purposes. (auth)

13332 AECU-3560

California. Univ. Berkeley. Minerals Research Lab.

FUNDAMENTALS OF GLASS-TO-METAL BONDING. VII. STUDIES ON WETTABILITY OF PLATINUM BY MOLTEN SODIUM SILICATE. Technical Progress Report No. 7. Molton L. Volpe, Richard M. Fulrath, and Joseph A. Pask. Aug. 1, 1957. 21p. Project No. 7. Contract AT(11-1)-34. $3.30(ph OTS); $2.40(mf OTS).

Further studies were made of the effect of the nature of the atmosphere on the wetting of Au and Pt by sodium disilicate at 1000°C. The gases used were O_2, N_2, CO_2, Ar, water vapor, CO, H_2, and several mixtures of some of these gases. Test pressures ranged from 10^{-5} mm of Hg to almost one atmosphere. A special experimental setup was constructed for this purpose. The results showed that the wetting of Au was unaffected by the atmosphere and that Au was thus inert. The platinum–sodium silicate contact angle, on the other hand, was dependent on the nature and the pressure of the gas. The results were interpreted on the basis of selective adsorption of the gases at the various interfaces and of absorption of O_2 and H_2 by Pt. (auth)

13333 AERE-CE/M-197

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

ANNEALING OF COPPER RINGS BY INDUCTION HEATING. A. R. Kenyon and P. M. C. Lacey. May 1957. 8p.

Copper rings needed for use in seals were annealed by heating in a reducing atmosphere, using them as the short circuited secondary in a simple transformer circuit. Rings so treated were completely free from blisters or other damage. (auth)

13334 AERE-CE/R-2170

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

A PRELIMINARY INVESTIGATION OF TECHNIQUES FOR THE MELTING AND POURING OF RADIOACTIVE METALS. PARTS I, II, AND III. B. T. Bell, R. F. Clayton, and F. Roberts. Feb. 1957. 33p.

This report is divided into three parts. Preliminary experiments were on the charging and melting problems, and Part I describes a method developed for continuous melting. Part II reviews the work carried out to date on pouring methods. Part III describes a versatile furnace which was designed and constructed for use in the program. (auth)

13335 BM-RI-5316

Bureau of Mines.

THERMODYNAMIC PROPERTIES OF TITANIUM–OXYGEN SOLUTIONS AND COMPOUNDS. Alla D. Mah, K. K. Kelley, Norma L. Gellert, E. G. King, and C. J. O'Brien. Dec. 1955. 35p.

Heats of formation of 11 Ti–O solutions, in the range of 0 to 10 wt. % oxygen, were determined at 298.15°K. As a byproduct, an improved value of the heat of formation of rutile was obtained, which, in turn, led to improved values of the heats of formation of the lower Ti–O compounds. Low-temperature heat-capacity data and entropies at

298.15°K were determined for 2 representative Ti–O interstitial solutions. High-temperature heat-content data were obtained for 2 Ti–O interstitial solutions to about 1,600°K. The experimental data have been correlated and expanded by theoretical means to yield partial molal heats, entropies, and free energies of the oxygen in the interstitial solutions. Partial molal-free energy-composition isotherms were computed at temperatures between 800 and 1,600°K for the composition range 0 to 2 wt. % oxygen. Comparison with free-energy data applying to possible metallic reductants for Ti–O solutions showed Ca to be the only one capable of reducing the oxygen concentration below 0.1 wt. % under technically feasible conditions. The other alkaline-earth metals and all of the alkali metals are much poorer reductants. (auth)

13336 KAPL-M-HEB-1

Knolls Atomic Power Lab., Schenectady, N. Y.

AN EVALUATION OF THE KAPL 3 × 3 ETR IN-PILE TUBE DESIGN. H. E. Barrie. Aug. 1, 1957. 39p. Contract W-31-109-Eng-52. $6.30(ph OTS); $3.00(mf OTS).

Gamma heating and neutron bombardment of a stainless steel in-pile loop for the ETR are expected to produce unprecedented stresses. Standard calculational procedures were used in an effort to evaluate these stresses. The calculations indicate the stresses will not exceed the design limits of the loop. (D.E.B.)

13337 KAPL-M-HOS-3

Knolls Atomic Power Lab., Schenectady, N. Y.

CLEANING OF CARBON, LOW ALLOY AND STAINLESS STEEL PIPE AND TUBING FOR NUCLEAR COOLANT SYSTEMS. Henry Suss. July 31, 1957. 11p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

The problems and applicability of the various standard methods for cleaning unirradiated individual lengths of carbon, low alloy, and AISI 300 series stainless steel piping and tubing for nuclear service are described. Details on cleaning methods and/or solutions to be used are contained in the bibliography. (auth)

13338 LA-2136

Los Alamos Scientific Lab., N.Mex.

TANTALUM ANNEALING AND DEGASSING AND HARDNESS EFFECTS OF DISSOLVED GASES. Ralph H. Perkins, Summers H. Cox, Robert K. Waits, and Harold M. Busey. May 15, 1957. 41p. Contract W-7405-eng-36. $1.25 (OTS).

The conditions for take-up and removal of dissolved gases in Ta metal have been determined, and the quantity of each gas has been correlated with the hardness of the metal. Under certain conditions, the measurement of hardness can serve as a rapid indicator of gas content. Oxygen, N_2, H_2, Ar, and He were studied. The latter two could be purified sufficiently to have no effect on Ta only by a previous run, or "gettering," on hot Ta. Work hardness of Ta can be annealed in vacuum at 1000°C, dissolved gas can be removed by heating at 2400°C for 1 hour with a final pressure less than 5×10^{-6} mm. (auth)

13339 NP-6434

Battelle Memorial Inst., Columbus, Ohio.

MOLYBDENUM AND MOLYBDENUM-BASE ALLOYS–MOLYBDENUM–THORIUM ALLOYS. Phase Report for the period May 1 through August 31, 1957. G. W. P. Rengstorff and R. B. Fischer. Sept. 15, 1957. 18p. Contract Nonr-1512 (00).

The distribution of Th in the worked structure and the resistance of the structure to recrystallization suggest that the Mo–Th alloys can be expected to have good strength at 2000°F, and perhaps to 2200°F or above. They should not exhibit the hot shortness found in previous tests on as-cast alloys. Further studies to ascertain the high-temperature properties appear to be warranted at this time. In the special application wherein it is known that Mo has excellent erosion resistance for mechanical properties, further study of the Mo alloys is warranted. A more complete investigation of fabrication conditions is desirable, especially to determine the best temperatures for working and the best time to interject a recrystallization treatment. Further studies are needed to determine a satisfactory method of making larger ingots. Formation of slag layers and the high emission properties of thorium complicate arc melting, but they are not insurmountable problems. The bend test experiment described here is a very preliminary excursion into what is believed to be a fruitful method of studying the deformation of molybdenum. A more detailed study combined with a comparison with other metals could lead to a real understanding of why minute amounts of some impurities have such a tremendous effect on grain-boundary strength of Mo and not on most other metals. The test shows that the Mo grains themselves are greatly distorted when the alloy is strained. Thus, most of the strain appears to be absorbed by the grains rather than by the Ti located in the grain boundaries. The study is too incomplete, however, to justify conclusions as to the mechanism wherein thorium imparts ductility to cast or recrystallized Mo. (auth)

13340 ORNL-2312

Oak Ridge National Lab., Tenn.

INVESTIGATION OF THE FACTORS AFFECTING SENSITIZATION OF ARMY PACKAGE POWER REACTOR (APPR-1)-FUEL ELEMENTS. R. J. Beaver, R. C. Waugh, C. F. Leitten, Jr., and W. R. Burt, Jr. Oct. 8, 1957. 21p. Contract W-7405-eng-26. $0.75(OTS).

Results are presented of the investigation necessitated by the unexpected intergranular attack of the type 304L stainless steel cladding in the Army Package Power Reactor (APPR-1) fuel plates after a flatten-annealing heat treatment and subsequent cleaning in 15% HNO_3–5% HF aqueous solution. This fuel plate consists of a powder-metallurgy-prepared core containing 26 wt. % UO_2 and 0.14 wt. % B_4C in a type 304B stainless steel matrix. After the core is fabricated into a composite fuel plate, it is 20 mils thick and is clad with 5 mils of type 304L stainless steel. The data accumulated permit an evaluation of the material specified for APPR-1 fuel plates with relation to the effect of the manufacturing heat treatments on carburization and sensitization of the type 304L stainless steel cladding. The effect of the substitution of type 347 stainless steel is also described. It is concluded that carbon diffusion from the type 304B fuel-core matrix increases the carbon level of the type 304L stainless steel cladding during the manufacturing heat treatments. The cladding is then susceptible to sensitization during the heat treatments and is subject to intergranular attack in a reducing acid. It was further concluded that substitution of type 347 stainless steel as the matrix material in the fuel core and the cladding, or as the cladding material only, would permit the fuel plates to be fabricated in accordance with the established APPR-1 manufacturing procedures without resulting in sensitization of the plate cladding. (auth)

13341 TML-78

Battelle Memorial Inst. Titanium Metallurgical Lab., Columbus, Ohio.

TITANIUM PRODUCTION DEVELOPMENTS INCLUDING METALLURGY AND ALLOYING. R. I. Jaffee. Aug. 5, 1957. 101p. Contract AF18(600)-1375.

The past, present, and future of the Ti industry is discussed in terms of costs and quantities of the metal produced. The nature and extent of present Ti ore

reserves are described as are the relative merits and disadvantages of the present extractive metallurgical processes being used for primary metal production. Descriptions are given of the various methods in use for the melting, casting, and fabrication of Ti and its alloys. Techniques of descaling, finishing, joining, and machining are also reviewed. The physical, chemical, and mechanical properties of current commercial alloys are summarized. The principles applying to the physical metallurgy of Ti and its alloys are also described. (auth)

13342 WADC-TR-57-251(Pt. I)
Case Inst. of Tech., Cleveland.
HIGH TEMPERATURE BRITTLENESS IN TITANIUM ALLOYS. [Period covered]: March 1956 to March 1957. Nick Makrides and W. M. Baldwin, Jr. Mar. 1957. 28p. Project title: METALLIC MATERIALS. Task title: TITANIUM METAL AND ALLOYS. Contract AF33(616)-3536. (AD-130847).

An alpha-Ti alloy (A-110-AT) containing 5% Al and 2.5% Sn, and an alpha-beta Ti alloy (Ti-140-A) containing 2% Cr, 2% Fe, and 2% Mo were each prepared (a) free from impurities, (b) with 0.2% O, (c) 0.2% C, and (d) 0.1% N for a program designed to explore strain aging phenomena, high-temperature brittleness, and stress-rupture behavior of titanium alloys. Tensile tests at different strain rates have been made on the alpha-alloy containing 0.1% N. The tests revealed a brittle range at 680°F (360°C) at a strain rate of 0.05 in./in./min. This brittle range was moved to 1020°F (550°C) employing a strain rate of 100 in./in./min. The minima in the ductility vs. temperature curves for the two strain rates when plotted on log strain rate vs. reciprocal absolute temperature coordinates gives a straight line (assumed) having a slope which is parallel to the line defining the diffusion coefficient of nitrogen in alpha-titanium. On the other hand, tests are still to be made on the impurity-free, alpha-alloy to see whether the brittleness occurs in the absence of nitrogen. A review was made of the various types of brittleness found at elevated temperatures in metals and alloys so that any brittleness encountered in titanium could be compared and identified. (auth)

13343 WADC-TR-57-298(Pt. 1)
Ford Motor Co., Dearborn, Mich.
IRON–ALUMINUM ALLOY SYSTEMS. PART I. FUNDAMENTAL STUDIES AND ALLOY DEVELOPMENT. Period Covered: April 1956 through March 1957. F. X. Kayser. Apr. 1957. 34p. Project title: METALLIC MATERIALS. Task title: HIGH TEMPERATURE ALLOYS. Contract AF-33(600)-32448. (AD-130823).

An extensive program is being carried on to study the mechanical and physical behavior of recrystallized Fe–Al alloys containing up to 18.5 wt. % Al. Data are presented illustrating the effect of Al on the stress-rupture and tensile properties. It is concluded that the recrystallized binary alloys are too low in hot strength to consider for use in moderate stress application at temperatures in excess of 1000°F. Special attention has been given to the development of higher hot strength alloys. The effect of Ti on hot strength is demonstrated. The effects observed of order-disorder transformations on mechanical properties are of fundamental interest. Some interesting and unique magnetic phenomenon have been discovered in the binary alloys among which is a continuous change from ferromagnetic to anti-ferromagnetic behavior. (auth)

13344 WADC-TR-57-298(Pt. 2)
Ford Motor Co., Dearborn, Mich.
IRON–ALUMINUM ALLOY SYSTEMS. PART 2. SOME INVESTIGATIONS IN AIR-MELTING AND APPLICATION OF IRON–ALUMINUM ALLOYS. Period Covered: April 1956 through March 1957. Joseph J. Clark and William J. Zager. Apr. 1957. 54p. Project title: METALLIC MATERIALS. Task title: HIGH TEMPERATURE ALLOYS. Contract AF-33(600)-32448. (AD-130824).

During the period April 1956 to April 1957 the Process Development Department of the Manufacturing Engineering Office of Ford Motor Company air-melted a series of heats of Fe–Al alloys in the 6 to 10% Al range. The melting and deoxidation of these heats, performed in indirect-arc type furnaces, are described. Mechanical properties obtained on bar stock rolled from ingots cast from a number of these heats are compared with established properties of vacuum-melted alloys of similar composition. Results of some exploratory heats involving changes in basic melting stock, as well as some with small additions of third elements, are presented. Initial attempts to produce sound castings in sand molds are described. Performance of certain Fe–Al alloy samples and fabricated articles in service is described. (auth)

13345 WADC-TR-57-298(Pt. 3)
Ford Motor Co., Dearborn, Mich.
IRON–ALUMINUM ALLOY SYSTEMS. PART 3: WELDING OF IRON–ALUMINUM ALLOYS. Period Covered: April 1956 through March 1957. R. Burthwick and S. Goodman. Apr. 1957. 68p. Project title: METALLIC MATERIALS. Task title: HIGH TEMPERATURE ALLOYS. Contract AF-33(600)-32448. (AD-130825).

Investigations were conducted to develop fusion welding and resistance welding procedures for three (3) heats of Fe–Al alloy. Successful fusion welding procedures were developed using the tungsten inert gas shielded arc process. Variables of power type, current, voltage, shielding, travel speed, cleaning, preheat and postheat were investigated. No definite resistance welding schedule was established, although, successful welds were realized with several schedules. Three fabrications were made using the fusion welding process in order to evaluate weld and material performance under service condition. The service evaluations had not been completed at the time of writing this report. (auth)

13346 WAL-401/267-1
Johns Hopkins Univ., Baltimore. Inst. for Cooperative Research.
STUDY OF THE STABILITY OF ARCS WITH TITANIUM ELECTRODES IN ARGON AND HELIUM. Technical Report No. 2 [on] FUNDAMENTAL CHARACTERISTICS OF TITANIUM ARCS IN THE INERT GASES. T. Benjamin Jones and E. Howard Young. Sept. 1956. 38p. DA Project No. 593-08-021. Contract DAI-36-034-505-ORD-(P)-1 RD.

This report outlines the results of a study of the stability of arcs in argon and helium where both electrodes were of titanium or titanium alloy material (consumable electrode welding process). The effects on cathode spot stability were determined for external fields of both magnetic and electric origin, special bare and coated electrodes, and for arcs supplied with d-c and a-c power. (auth)

13347 WAL-401/282
Watertown Arsenal Lab., Mass.
UNIFORMITY OF COMMERCIAL TITANIUM ALLOY INGOTS. PHASE I: ALLOYS Ti–6% Al–4% V AND Ti–8% Mn; INGOTS PROCURED FROM MALLORY-SHARON TITANIUM CORPORATION, NILES, OHIO. Stuart V. Arnold. Aug. 1957. 21p. DA Project 5B93-08-021.

13348 AEC-tr-3036
RELATIONSHIP OF PHYSICO-CHEMICAL PROPERTIES OF CARBIDES. I. S. Gaev. Translated from Zhur. Neorgan. Khim. 1, 193-211(1956). 28p.

The relationship of the physico-chemical properties of carbides to their transformation in steel has been studied. The heat of formation, the thermochemical stability, the refractoriness, and hardness of carbides in relation to the position of the elements on the Mendeleev table have been evaluated. (R.V.J.)

13349 AERE-Lib/Trans-744

INVESTIGATION OF ELECTROCAPILLARY PHENOMENA IN TIN–GOLD AND BISMUTH–TELLURIUM ALLOYS. S. Karpachev and E. Rodigina. Translated by T. Turton from Zhur. Fiz. Khim. 23, 953-8(1949). 9p.

Electrocapillary phenomena have been investigated in liquid Sn–Au and Bi–Te alloys. In both of the cases investigated clearly expressed minima of surface tension were observed. Zhukhovitskii's theory was used to investigate the conditions of existence of surface tension maxima and minima for the boundary of a binary metal alloy with its saturated vapor. The extremes exist due to deviations of the alloys from the laws of ideal solutions. It was shown that in the case of a positive deviation of the alloy's behavior from the behavior of ideal solutions there should be a maximum, while in the case of negative deviation there should be a minimum. When the surface tensions of pure components are equal the extremum always lies at a value of the mole fraction of 0.5. Differences in surface tensions of the pure components cause the extremum to deviate in composition one way or the other from the value 0.5. (auth)

13350

RESTORATION OF INTERNAL FRICTION IN PURE ALUMINUM AFTER REMOVAL OF A LOAD. V. S. Postnikov (Kemerovskii State Pedagogical Inst.). Doklady Akad. Nauk S.S.S.R. 114, 1228-30(1957) June 21. (In Russian)

The isothermal restoration of internal friction in wire specimens, 0.7 mm in diam. and 320 mm in length, prepared from pure 99.98% Al and deformed by tension, has been investigated using low frequency, small amplitude torsion vibrations. Diagrams of curves were plotted to determine the relation of the friction restoration process to the temperature (up to 500°C) and load removal. (R.V.J.)

TRACER APPLICATIONS

13351

RADIOACTIVITY OF POTASSIUM AND GEOLOGIC TIME. G. W. Wetherill (Carnegie Inst. of Washington, D. C.). Science 126, 545-9(1957) Sept. 20.

13352

THORIUM CONTENT OF STONE METEORITES. George L. Bate and J. R. Huizenga (Argonne National Lab., Lemont, Ill.) and Herbert A. Potratz (Los Alamos Scientific Lab., N. Mex.). Science 126, 612-13(1957) Sept. 27.

PHYSICS

13353 AECD-4246

[Yale Univ., New Haven.]

PHOTON SPECTRUM FROM BREMSSTRAHLUNG. R. L. Gluckstern, M. H. Hull, Jr., and G. Breit. Aug. 11, 1953. Decl. Mar. 18, 1957. 28p. (Yale (LA)-3). $4.80(ph OTS); $2.70(mf OTS).

The number of photons of given energy radiated in Bremsstrahlung collision of electrons with nuclei is calculated relativistically. Expansions are obtained for energies small compared to mc^2. The photon spectrum is averaged over a Maxwell distribution for the electrons. Numerical results are included. (auth)

13354 APEX-320

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

CORRELATION OF DATA FOR PRESSURE LOSS IN A CANNULAR J-73 COMBUSTOR. R. E. Motsinger. Aug. 9, 1957. 25p. Contracts AF33(038)-21102 and AT(11-1)-171. $0.75(OTS).

When using a heat exchanger in series with a chemical combustor with a turbojet engine as a test vehicle, the pressure loss of the combustor is a critical factor. This study evaluates the pressure loss in a combustor over a wide range of inlet conditions. (T.R.H.)

13355 HARE-15

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

PUMPING OF THORIA SLURRIES IN 1" GLASS LOOP. R. Murdoch and E. R. Jaques. June 14, 1955. 15p.

Thoria slurries, in concentrations up to 1.87 g ThO_2/g H_2O, have been circulated without difficulty in a 1-in. glass loop, at mean linear velocities between 9.0 and 16.0 fps. Friction pressure drop measurements were made, and these are compared with values calculated by making different assumptions about apparent viscosity. (auth)

13356 K-1346

Oak Ridge Gaseous Diffusion Plant, Tenn.

A SIMPLIFIED MODEL OF THE ELASTIC SCATTERING OF MOLECULAR BEAMS FROM SOLID SURFACES. W. C. DeMarcus and A. J. Beck, Jr. Oct. 7, 1957. 20p. Contract W-7405-eng-26. $0.75(OTS).

Theory of the elastic scattering of molecular beams by single atoms imbedded in an otherwise perfectly plane surface is presented. The solution process employed closely parallels the classic method of Faxen and Holtsmark which was developed to describe the scattering of molecular beams by isolated atoms. Indeed, it turns out that if one has available the phases shifts for describing scattering by isolated atoms, then the surface scattering problem may be considered as solved although the phase shifts enter the final results with different weights. In an appendix, a general result of nuclear physics is used as a model to derive similar results about the relative magnitudes of "sticking" cross-sections and elastic cross-sections. (auth)

13357 KAPL-M-ALM-4

Knolls Atomic Power Lab., Schenectady, N. Y.

HYDROGENOUS MODERATOR MEASUREMENTS IN THE ACME AND PMA. A. L. MacKinney. [July 1957]. 16p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

Reactivity coefficients of hydrogenous compounds were measured in ACME and PMA in order to analyze the reactivity of the moderator in these assemblies. Evaluation of the hydrogen reactivity coefficient based on measured values of carbon, oxygen, and the compounds does not lead to systematic variations for the hydrogen reactivity coefficients computed from different hydrogenous compounds. Calculation of the carbon, oxygen, and hydrogen reactivity coefficients from the simultaneous solution of various hydrogenous compounds leads to results which permit calculation of the reactivity coefficient of an arbitrary hydrogenous compound. In addition, comparison of the reactivity of the plastic to that of water permits a determination of the water temperature simulated by a plastic assembly. (auth)

13358 NP-6419

Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

QUARTERLY PROGRESS REPORT NO. 46 FOR PERIOD ENDING MAY 31, 1957. J. B. Wiesner, G. G. Harvey, and

H. J. Zimmermann. July 15, 1957. 182p. Project 3-99-00-100. Contract DA-36-039-sc-64637.

Physical Electronics. Studies on characteristics of Ge junctions, surface states on semiconductors, and spectral emissivity of W are reported. Microwave Gaseous Discharges. The investigations in which progress is reported are: frequency of electron loss in a microwave-maintained plasma; high frequency breakdown in magnetic fields; microwave determination of plasma density distribution; plasma diamagnetism; and inhomogeneous magnetic field design. Research is reported in other sections on microwave spectroscopy, microwave electronics, and microwave theory. Solid State Physics. Breakdown of single crystal Ge with Zn impurities by microwave electric fields at 4°K was studied. Nuclear Magnetic Resonance and Hyperfine Structure. Studies were conducted on molecular motion in solids, energy level populations in electron impact excited atoms, magnetic dipole moment and isotope shift in Hg^{197}, and use of analytic wave functions in determining nuclear moments and application to quadrupole moment of B^{11}. Atomic Beams. A small Ti ion pump and a crystal oven temperature control are described. Research is also reported in the following fields: Statistical Communication Theory; Process Analysis and Synthesis; Processing and Transmission of Information; Transistor and Diode Studies; Noise in Electron Devices; Statistical Thermodynamics; Speech Analysis; Mechanical Translation; Communications Biophysics; Neurophysiology; Circuit Theory; and Network Synthesis. (For preceding period see NP-6319.) (T.R.H.)

13359 RM-1922(RAND)

RAND Corp., Santa Monica, Calif.

A CASEBOOK ON SOVIET ASTRONAUTICS. PART II. F. J. Krieger. June 21, 1957. 207p. (AD-133018).

Bibliographies are given of Russian books and periodicals dealing with various aspects of rocketry and astronautics. A series of complete translations of Russian articles and papers showing the singleness of purpose in the Soviet space flight program is included. (For part I see abstract RM-1760.) (R.V.J.)

13360 SCTM-205-57(16)(Del.)

Sandia Corp., Albuquerque, N. Mex.

PROPERTIES OF COPPER-CLAD PLASTIC LAMINATES FOR ETCHED PRINTED CIRCUIT BOARDS. R. E. Whitford. Sept. 9, 1957. 12p. Contract AT(29-1)-789. $3.30(ph OTS); $2.40(mf OTS).

Measurements made of the properties of printed circuit test specimens prepared by photoetching various types of Cu-clad laminates are reported. The purposes of the tests were to determine a factor of merit between the properties of the different types of laminates commercially available for etched circuits and to obtain property values for use in preparing material standards. (auth)

13361 UCRL-4900

California. Univ., Livermore. Radiation Lab.

THE EQUATION OF STATE OF THE ALKALI HALIDES AT HIGH PRESSURE (thesis). Russell H. Christian. May 16, 1957. 89p. Contract W-7405-eng-48. $13.80 (ph OTS); $4.80(mf OTS).

The dynamic compressibility of the alkali halides is determined up to a pressure of 300,000 bars by shock-wave measurements. Isotherms are estimated for comparison with the available static data and various theoretical or empirical curves. Excellent agreement is obtained with the static compressibility curves, including the occurrence of polymorphic transitions. This is strong evidence for the "hydrostatic" nature of the pressure behind a strong shock. The expected transition in the sodium salts is not found. Empirical curves are calculated for the power law form of the repulsive potential between the ions and for the Born-Mayer or exponential form. The empirical constants are determined from the lattice spacing and compressibility at zero pressure and corrected to zero temperature. The power law yields a reasonable fit in most cases with a tendency to be too stiff at the higher pressures. The power of the repulsive potential varies from 6 for LiF to 12 for CsI. The exponential form results in curves that are often in slightly better agreement with the experimental data. This form is also preferable in that the constant in the exponent varies less, from about 3.5 1/A for the fluorides to 2.8 1/A for the iodides, and is relatively insensitive to the positive ion. (auth)

13362

RELATIVE VOLATILITY OF H_2O^{16}/H_2O^{18} AND EQUILIBRATION TIME FOR FRACTIONAL DISTILLATION OF WATER. Sadahiro Sakata and Noriyoshi Morita (Nagoya Univ., Chigusa-ku). Bull. Chem. Soc. Japan 30, 254-9 (1957) Apr.

By applying values of the natural abundance of D, O^{18}, and O^{17} in normal water (respectively, 15.8, 244.7, and 21.9 in γ units) and the relative volatility of $H_2O/HDO = \sqrt{1.052}$ and by assuming that the plate efficiency of the fractionation column is identical for H and O isotopes, it is concluded that 1.0039 ± 0.0002 is the relative volatility of H_2O^{16}/H_2O^{18} (auth)

COSMIC RADIATION

13363

FACTORS AFFECTING THE GALACTIC DIFFUSION OF COSMIC RAYS. Howard Laster (Cornell Univ., Ithaca, N. Y.) and Univ. of Maryland, College Park). Phys. Rev. 107, 1112-18(1957) Aug. 15.

Some of the effects of spatial and time inhomogeneities upon the galactic diffusion of cosmic rays are studied. It is noted that the ways in which spatial inhomogeneities alter the anisotropy with changing energy are very dependent upon the particular model for cosmic-ray origins chosen. The consequences of assuming bursts of cosmic rays occuring randomly in time instead of continuously are examined. It is shown that in a monoenergetic approximation this possibility would be unobservable, regardless of the frequency of the bursts. The above calculations are first done for generalized medium shapes. They are then applied to a specific model in order to examine their consequences. (auth)

13364

TIME VARIATIONS OF EXTENSIVE AIR SHOWERS. F. J. M. Farley and J. R. Storey (Auckland Univ. Coll., New Zealand). Proc. Phys. Soc. (London) B70, 840-4(1957) Sept.

Extensive air showers corresponding to primary cosmic rays ranging from 10^{14} to 3×10^{15} ev were recorded at Auckland for the year 1955. The results do not confirm the large sidereal diurnal effect reported previously. (auth)

13365

ON THE AIR SHOWER CORE. Shun-ichi Hasegawa (Osaka Univ., Japan). Progr. Theoret. Phys. (Japan) 17, 603-5 (1957) Apr.

The effect of the angular spread of π° mesons produced by high energy jet showers is considered, which will make the lateral distribution of the soft components near the core less steep than that predicted only by the single cascade theory. The theoretical lateral distribution of soft component at the place of observation is calculated, assuming the shape of the angular distribution of π°-mesons as well as

the altitude at which they are produced. Then, comparing this result with experimental data gives information about the angular spread of π^0 mesons produced by high energy jet showers In this calculation, only the spatial distribution of π^0 mesons is considered, assuming the one-dimensional development of subsequent cascade showers. (M.H.R.)

13366

THE APPLICABILITY OF THE Be^{10} METHOD TO MEASUREMENT OF COSMIC RAY INTENSITY AND AGING OF SEA SEDIMENTS FOR A MILLION YEARS. B. Peters. Z. Physik 148, 93-111(1957). (In German)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

13367

COLOUR CENTRES IN IRRADIATED DIAMONDS. I. C. A. Coulson and Mary J. Kearsley (Oxford Univ.). Proc. Roy. Soc. (London) A241, 433-54(1957) Sept. 10.

A theoretical calculation of the energy levels, and hence absorption spectrum, of an isolated vacancy in an otherwise perfect diamond lattice has been made. The concept of a defect molecule is introduced. This enables familiar molecular orbital theory to be applied in calculating the electronic structure of the defect. The quantitative results suggest that the observed band at 2.0 ev causing irradiated diamonds to appear blue, is due to spin and orbitally allowed electronic transitions of symmetry $^1E \rightarrow {}^1T_2$ in the neighborhood of isolated neutral vacancies. (auth)

13368

ELECTRIC CONDUCTIVITY MEASUREMENT OF SILVER HALIDE CRYSTALS. R. Matejec. Z. Physik 148, 454-95 (1957). (In German)

13369

ELECTROLUMINESENCE OF DIAMOND. Albrecht Fischer. Z. Physik 149, 107-10(1957). (In German)

ELECTRICAL DISCHARGE

13370 AERE-T/R-2138

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

THE INFLUENCE OF CONDUCTING WALLS ON THE WRIGGLING GAS DISCHARGE. PART I. WALLS OF INFINITE CONDUCTIVITY. S. J. Roberts and R. J. Tayler. Jan. 1957. Decl. July 22, 1957. 38p.

Roberts, Sturrock, Thompson, and Whipple calculated the magnetic forces acting on a current channel in free space, and showed that these forces cause such a discharge to be liable to wriggling instabilities. The effect on instability of confining the discharge within perfectly conducting cylindrical walls is considered for two disturbed discharge configurations, one plane sinusoidal and the other helical, and the effects of induced currents in the walls are shown to be qualitatively the same in each case. For long wavelengths the net force is inward for arbitrarily small amplitude of disturbance, and the discharge is thus stable against such disturbances. The stability criteria are in agreement with those obtained from a hydromagnetic model of the discharge. The effect of non-linear forces was also studied, and an estimate of the amplitude to which unstable disturbances will grow was obtained. It was found that the non-linear effects are not pronounced until the discharge is close to the wall; the wavelength which will travel 80% of the distance to the wall is about 25% less than the wavelength which just fails to grow. (auth)

13371

AN ION BLOWER FOR THE ELIMINATION OF STATIC ELECTRICITY. Knut Ljunggren (Royal Inst. of Tech., Stockholm, Sweden). Intern. J. Appl. Radiation Isotopes 2, 105-9(1957).

An ion blower transporting ionized air from the vicinity of a shielded radioactive source towards electrostatically charged areas has been constructed and investigated with respect to air ionizing efficiency at varying distances, air velocities, and source strengths. Some results are given which indicate that the ion blower can be used efficiently for producing ionization currents up to 0.1 μA with no accompanying radiation from β-emitting sources of about 50 mc. When stronger sources are used, recombination limits the efficiency of the ion blower, making the ionization almost dependent of source strength. (auth)

ELECTRONS

13372

COULOMB INTERACTIONS AND THE DIAMAGNETISM OF FREE ELECTRONS. II. Hideo Kanazawa (Univ. of Tokyo, Japan). Progr. Theoret. Phys. (Japan) 17, 1-5(1957) Jan.

The effect of the term $\Delta j(x)$, which should be added to the current density operator $j(x)$, on the Landau diamagnetism is investigated. It is shown that the magnitude of the diamagnetic susceptibility slightly increases due to the long-range part of the Coulomb interactions between electrons. (auth)

13373

INVESTIGATION OF THE LOSS OF ENERGY OF SLOW ELECTRONS IN NITROGEN. Rudolf Haas. Z. Physik 148, 177-91(1957). (In German)

The inelastic reaction of N molecules and electrons of 1 to 5.6 ev energy was investigated by a known elastic impulse method. Measurements were made in inert gas–nitrogen mixture. (tr-auth)

GASES

13374 AECU-3558

Little (Arthur D.) Inc., Cambridge, Mass. and Cambridge Corp., Cambridge, Mass.

CALCULATION OF PARAMETERS FOR LOW PRESSURE GAS LIQUEFACTION CYCLES. Howard O. McMahon and Gerald H. Golden. Mar. 1, 1953. 186p. Contract AT(29-1)-1322. (CAMCO-LA-1). $28.80(ph OTS); $8.40(mf OTS).

A thermodynamic study was made to determine optimum operating conditions for several variations of each of two basic systems for liquefying hydrogen at low working pressures. In the first of these, the hydrogen system, compressed hydrogen is liquefied by low pressure Joule-Thomson expansion after having been precooled with one or more cold streams of isentropically expanded hydrogen. In the second, the helium system, hydrogen at a pressure of one atmosphere is liquefied directly by refrigeration with one or more cold streams of isentropically expanded helium. The optimum operating conditions are presented in a series of graphs and tables, and the use of these in designing a practical low pressure hydrogen liquefaction system is illustrated in detail. (auth)

13375

THE USE OF GAMMA RADIATION IN THE STUDY OF THE EXPANSION OF GAS–LIQUID SYSTEMS. E. J. Gibson, J. Rennie, and B. A. Say (Fuel Research Station, Greenwich). Intern. J. Appl. Radiation Isotopes 2, 129-35(1957).

The technique of gamma absorptiometry has been applied in a study of the mechanics of a gas/liquid system at pressures up to 20 atm and temperatures up to 260°C. The study was made using water-gas and liquid paraffin in a reactor

designed for the Fischer-Tropsch synthesis. The equipment used is described. It is shown how differences in density between the top and bottom of the bed can be measured, and how the expansion and frothing of the liquid varies with gas velocity and pressure. The technique has proved very useful in plant control during synthesis experiments. (auth)

13376
NEWTONIAN DEVELOPMENT OF THE DYNAMICAL PROPERTIES OF IONIZED GASES OF LOW DENSITY. E. N. Parker (Univ. of Chicago, Ill.). Phys. Rev. 107, 924-33(1957) Aug. 15.

The macroscopic dynamical equations of a tenuous ionized gas in a magnetic field are developed by averaging over the individual ion and electron motions, which do not necessarily possess an isotropic distribution. It is shown that the principal motion of the gas is related to the magnetic field by the usual hydromagnetic equations, as developed for conducting liquids and dense gases; the anisotropy of the individual particle motions shows up primarily as a coefficient multiplying the pondermotive force exerted by the magnetic field on the plasma. The results reduce properly to the earlier work of Schlüter, Cowling, and Spitzer for isotropic pressure, and are in agreement with the recent developments from the Boltzmann equation. It is pointed out that the magnetic lines of force are permanently connected and move in the frame of reference of the electric drift. It is shown that near static equilibrium, when the principal motions vanish, there remain small macroscopic drift motions of the gas in the field inhomogeneities. It is also shown that the field equations, obtained by assuming that the radius of gyration of the thermal motions is small compared to the scale of the field, are valid even near neutral surfaces, on which the field density vanishes. (auth)

INSTRUMENTS

13377 AECU-3564
Oak Ridge Gaseous Diffusion Plant, Tenn.
THE THEORY OF A ROTATING CYLINDER VISCOMETER IN THE KNUDSEN PRESSURE REGIME. W. C. DeMarcus. June 28, 1957. 7p. Contract [W-7405-eng-26]. $1.80 (ph OTS); $1.80(mf OTS). (KOA-283).

13378 AERE-GP/R-2238
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
MULTIPLE-CHAMBER SHOCK TUBES. K. Dolder. May 1957. 13p.

Shock strengths produced in conventional shock tubes are increased if the temperature and pressure of gas in the compression chamber is raised. This report considers tubes in which gas in the compression chamber is heated and compressed by an incoming shock. Such a shock can be generated if one or more chambers are added to a conventional two chamber tube. Then, if the pressure in the additional section is greater than that in the compression chamber, and the two sections are initially separated by a diaphragm, a shock will enter the compression chamber when this diaphragm is removed. Shock strengths in multiple-chamber tubes were measured in two sets of experiments. In the first set, with air in all chambers, good agreement with theory was found. In the second set, with argon in the expansion chamber and hydrogen in the compression and additional chambers, the observed shock strengths were lower than those predicted theoretically and this descrepancy is discussed. In both cases useful gains in shock strength resulted from the inclusion of additional chambers. (auth)

13379 AERE-X/M-169
Cambridge Univ., England.
TESTS WITH MERCURY OF ROTARY FLOWMETER FOR LIQUID METALS. J. A. Shercliff. May 1957. 10p.

Tests are described on a novel and simple type of flowmeter in which magnets mounted on wheels are dragged around by the motion of a liquid metal in an offset tube between the wheels. The optimum degree of offset was established with a non-conducting tube and the meter's characteristics studied. Owing to the size of the frictional forces in comparison with the magnetic forces when mercury was employed, the results were liable to high scatter, and when the mercury flowed in a conducting stainless steel tube, sustained steady running was impossible under the conditions available, although deceleration measurements showed the presence of the magnetic driving force. (auth)

13380 SCTM-92-57(14)
Sandia Corp., Albuquerque, N. Mex.
BOOLEAN ANALYSIS OF ORDINARY AND OSCILLATORY BINARY COUNTERS. M. B. Marcus. Sept. 18, 1957. 19p. Contract [AT(29-1)-789]. $3.30(ph OTS); $2.40 (mf OTS).

Boolean Algebra is extending to facilitate the analysis and synthesis of regenerative switching circuits. For illustrative purposes, several transistorized binary counters of two types are developed. (auth)

13381 AEC-tr-3041
INTERFEROMETRIC OBSERVATIONS OVER CURRENT ANOMALIES AT THE CATHODES. H. J. Antweiler. Translated from Z. Elektrochem. 43, 596-7(1937). 3p.

Concentrations of mercury droplets in the drop-diffusion layer during electrolysis were made visible with the interferometric Schlieren apparatus. The increased current strength at a maximum was attributed to agitation. (R.V.J.)

13382
PROCEEDINGS OF THE 1957 NATIONAL NUCLEAR INSTRUMENTATION CONFERENCE, ATLANTA, GEORGIA, APRIL 10, 11, 12, 1957. Pittsburgh, Instrument Society of America, 1957. 145p.

Papers are included on the instrumentation of the Brookhaven Medical Reactor, the Oak Ridge Research Reactor, the chemical plant for the Homogeneous Reactor Test, processing with nuclear energy, nuclear nondestructive testing, and the subcritical assembly. Other were presented on design and uses of a light-water-moderated subcritical assembly, materials for construction of radiation instruments, instrumentation and control of an inpile pumped solution loop, the gamma ray densitometer and concentration meter, design and instrumentation of Georgia Institute of Technology radioisotopes laboratory, constant air monitoring, ten channel area monitoring, a self-powered radiant energy pulse recorder without moving parts, a nuclear reactor simulator for training, detector design studies at Argonne National Laboratory, safety instrumentation and problems encountered in the University of Florida nuclear program, measurement of low-level γ activity in the human body, microscopy in radioactive waste treatment by dilution, and nuclear instrumentation in the Emory University medical program. (M.H.R.)

MASS SPECTROGRAPHY

13383 AERE-CP/R-1572
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
THE ISOTOPIC ANALYSIS OF LITHIUM BY MASS SPECTROMETRY. G. H. Palmer, J. E. Johnson, D. B. McCulloch, and T. F. Johns. Nov. 29, 1954. Decl. July 3, 1957. 7p.

By use of the technique of the multifilament source and $LiNO_3$ as the working material, it is possible to obtain reproducible results on the isotopic analysis of the Li isotopes. The precision of the method is such that it is possible to detect a 1% change in the isotopic ratio of normal Li. (auth)

MATHEMATICS

13384 AERE-GP/M-191
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
NOTE ON CONVERGING SHOCKS. R. Hide. June 1956. 9p.

13385 KAPL-M-JA-5
Knolls Atomic Power Lab., Schenectady, N. Y.
FINAL SUPPLEMENT TO RÉSUMÉ OF TOPSY OPERATING INSTRUCTIONS. Julius A. Archibald, Jr. May 15, 1957. 9p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).
Supplement to KAPL-M-JA-1 AND KAPL-M-JA-3.

13386 AEC-tr-3049
GAUSS'S WORK (1803–1826) ON THE THEORY OF LEAST SQUARES. Carl Friedrich Gauss. Translated by Hale F. Trotter from a French translation by J. Bertrand. 186p.
Issued as Technical Report No. 5 under contract DA-36-034-ORD-2297 (Princeton Univ.) dated Aug. 5, 1957.

MEASURING INSTRUMENTS AND TECHNIQUES

13387 AERE-NP/R-2251
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
THE CONSTRUCTION AND OPERATION OF A SINGLE CRYSTAL NEUTRON SPECTROMETER. N. J. Pattenden and A. H. Baston. May 21, 1957. 29p. $0.90(OTS)
A detailed description is given of the methods of construction and operation of a neutron crystal spectrometer employing a Be monochromator. A brief description is given of some experimental results obtained with the spectrometer. (auth)

13388 CISE-57
Centro Informazioni Studi Esperienze, Milan.
ORIENTAMENTI SUI RIVELATORI DI NEUTRONI PER SELETTORI MECCANICI VELOCI. (Orientation on Neutron Detection by Rapid Mechanical Selection). M. Forte. Apr. 5, 1957. 41p.

13389 LA-2095
Los Alamos Scientific Lab., N. Mex.
THE SMALL-VOLUME INTERNAL SAMPLE LIQUID SCINTILLATION COUNTER: INSTRUMENTATION, PERFORMANCE CHARACTERISTICS AND CAPABILITIES. F. Newton Hayes and Donald G. Ott. Jan. 1957. 37p. Contract W-7405-eng-36. $0.30(OTS).
Fundamental considerations and practical data are presented for the small-volume internal-sample liquid scintillation counter. Steps in the complex transformation from disintegration of a radioactive nuclide to emergence of a count on the scaler are explored for their physical significance. Characteristic data are given for H^3, C^{14}, and background counting with a representative coincidence instrument. A comprehensive guide to the conversion from assay sample to counting solution is offered. (auth)

13390
A GRAPHICAL ABSOLUTE METHOD FOR RANGE DETERMINATION OF β-PARTICLES. F. Barreira and M. Laranjeira. Intern. J. Appl. Radiation Isotopes 2, 145-8(1957).
A graphical method for range determination of β-particles is described. No comparative isotope is used in its application. The absorption curve is plotted against a straight line. A transformed curve, obtained in this way, enables us to deduce the desired range, by a graphical extrapolation over the unknown region of the absorption curve. (auth)

13391
A USEFUL FORMULA FOR CALCULATING THE COUNTING RATE OF A DETECTOR IMMERSED INTO EXTENDED GASES AND LIQUIDS. Gunnar Aniansson and Lars-G. Erwall (Royal Inst. of Tech., Stockholm, Sweden). Intern. J. Appl. Radiation Isotopes 2, 166(1957).

13392
CONTINUOUSLY SENSITIVE BUBBLE CHAMBER. Robert H. Good (Univ. of California, Berkeley). Phys. Rev. 107, 1201(1957) Aug. 15.
This chamber employs a solution of CO_2 in isoamyl acetate; methanol, ethanol, acetone, and tributyrin with CO_2 produce similar results. This solution is cooled at the bottom and heated at the top giving a narrow sensitive layer where bubbles form and rise to the surface when a neutron source is brought close to the chamber. (M.H.R.)

13393
A MULTICHANNEL PULSE AMPLITUDE ANALYSER. P. K. Iyengar, P. N. Rama Rao, G. Venkataraman, and K. Usha (Atomic Energy Establishment, Trombay, Bombay). Proc. Indian Acad. Sci. 46, 61-71(1957) July.
Modifications introduced in the decoding units of the Wilkinson pulse analyzer to make the instrument as simple as possible, without lowering its speed of analysis, are summarized. (M.H.R.)

13394
THE LIGHT YIELD OF ANTHRACENE FOR ELECTRONS FROM 20 TO 160 kev. Klaus-Werner Hoffmann. Z. Physik 148, 303-7(1957). (In German)
The β spectra of S^{35} in the energy range between 20 and 167 kev are measured with the aid of an anthracene cleavage crystal spectrometer. (tr-auth)

13395
REPORT OF THE CONFERENCE ON RECENT DEVELOPMENTS IN CLOUD-CHAMBER AND ASSOCIATED TECHNIQUES. N. Morris and M. J. B. Duff, eds. London, University College, 1956. 238p.
Papers were presented on the diffusion cloud chamber, the multiplate cloud chamber, scintillation and Cherenkov counters for cloud chamber selection systems, the high pressure Wilson cloud chamber, the bubble chamber, the fast cycling expansion cloud chamber, and the interpretation of cloud chamber photographs. (M.H.R.)

MESONS

13396 UCRL-3891
California. Univ., Berkeley. Radiation Lab.
THE INTERACTION OF 190 MEV K^+ MESONS ON H, C, Al, Cu, Ag, AND Pb. Leroy T. Kerth, Thaddeus F. Kycia, and Ludwig van Rossum. Sept. 11, 1957. 8p. Contract W-7405-Eng-48. $1.80(ph OTS); $1.80(mf OTS).
A counter experiment to measure the attenuation of K^+ mesons in various materials was completed. From the attenuation cross sections measured by a transmission-type experiment and from the differential-scattering cross section for one angle, the real and imaginary parts of the potential have been calculated by use of the optical model. A modification was made in the optical model by using the nucleon-density distribution determined by electron scattering experiments. As previously reported the average

real potential is 24.2 ± 2.3 Mev. No attempt was made to fit the data with an attractive potential. The cross section for protons is found to be 15.4 ± 3 mb. The average K-nucleon cross section in the elements with Z between those of carbon and lead, derived from the imaginary potential, is approximately 10 mb. (auth)

13397 UCRL-3892

California. Univ., Berkeley. Radiation Lab.

HYPERON AND NEGATIVE K-MESON MASSES. W. H. Barkas, P. C. Giles, H. H. Heckman, F. W. Inman, C. J. Mason, and F. M. Smith. Sept. 1957. 7p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

Our program of study on the interactions of K^- mesons in nuclear track emulsion led to estimates of the masses of K^-, $\Sigma^\pm$, and Λ^0 particles. To obtain reliable measurements particular attention was placed in the determination of the emulsion density and shrinkage factor. The range measurement techniques employed are the same as those developed in an extensive study of the range-energy for emulsion. Area scanning for Λ^0 decays in the region of the stopped K^- mesons was initiated, and to date 27 $\Lambda^0 \rightarrow p + \pi^-$ decays have been tentatively identified. The Λ^0 mass and its Q value are results based upon 23 events completely analyzed. The proton and pion masses assumed are 938.21 ± 0.01 and 139.63 ± 0.06 Mev, respectively. The mass measurement results are: K^- = 493.2 ± 0.6 Mev, Σ^+ = 1189.30 ± 0.3 Mev, Σ^- = 1195.8 ± 0.7 Mev, Λ^0 = 1115.30 ± 0.16 Mev, and Q_{Λ_0} = 37.45 ± 0.17 Mev. (auth)

13398

STUDY OF TERMS FOR SEVERAL MESONS IN THE EQUATION OF CHEW AND LOW. Roland Omnes. Compt. rend. 243, 1019-20(1956) Oct. 8. (In French)

An integral linear equation was obtained for the matrix for production of a supplementary meson by a meson in the approximation of a static nucleon. (tr-auth)

13399

A COMPLETE SYSTEM OF INTEGRAL EQUATIONS OF THE TYPE OF LOW. Roland Omnes. Compt. rend. 244, 47-9(1957) Jan. 2. (In French)

In the study of some terms for mesons in the static nucleon theory of Wick, Chew, and Low, a complete system of integral quadratic equations was established between the elements of the collision matrix, T. These equations, as a rule, completely define the S matrix. (tr-auth)

13400

POSSIBLE VIOLATION OF CHARGE INDEPENDENCE IN STRONG INTERACTIONS. J. J. Sakurai (Cornell Univ., Ithaca, N. Y.). Phys. Rev. 107, 908-9(1957) Aug. 1.

The reaction $\pi^+ + p \rightarrow \Sigma^+ + K^+$ was studied, and a possible violation of charge independence in the reaction is reported. (L.T.W.)

13401

μ-MESON POLARIZATION IN A STRONG MAGNETIC FIELD. Walter H. Barkas, Peter C. Giles, Harry H. Heckman, Fred W. Inman, and Frances M. Smith (Univ. of California, Berkeley). Phys. Rev. 107, 911-12(1957) Aug. 1.

13402

COLLISIONAL DE-EXCITATION OF μ-MESONIC ATOMS. T. B. Day and P. Morrison (Cornell Univ., Ithaca, N. Y.). Phys. Rev. 107, 912-13(1957) Aug. 1.

It is shown that processes can occur in condensed matter which de-excite mesonic atoms rapidly enough to provide the observed competition of nonradiative processes with radiative transitions as the μ meson seeks its ground state. (L.T.W.)

13403

HIGH-ENERGY π-He EXPERIMENTS: CHARGE SYMMETRY AND THE DETERMINATION OF THE K-MESON SPIN. J. J. Sakurai (Cornell Univ., Ithaca, N. Y.). Phys. Rev. 107, 1119-20(1957) Aug. 15.

The associated production of K particles and hypernuclei in high-energy π-He interactions may be studied to verify charge symmetry at small distances, to determine conclusively the spin of the K meson (as long as angular momentum is conserved), and to detect a possible effect due to the nonconservation of angular momentum. (auth)

13404

MESON PRODUCTION IN MESON-NUCLEON COLLISION. Emil Kazes (Univ. of Chicago, Ill.). Phys. Rev. 107, 1131-5(1957) Aug. 15.

By using the Chew-Low theory, meson production cross sections in meson-nucleon collisions have been calculated. The various production amplitudes, in the one-meson approximation, yield integral equations whose kernels involve scattering phase shifts. For these, experimental or theoretical phase shifts were used. Calculations with pseudoscalar mesons show that, for coupling constants deduced from scattering, the Born approximation differs greatly from the results of the one-meson approximation. Agreement with experiments at 470 Mev is good but not decisive. (auth)

13405

PHOTOPRODUCTION OF K^+ MESONS IN HYDROGEN. P. L. Donoho and R. L. Walker (California Inst. of Tech., Pasadena). Phys. Rev. 107, 1198-1200(1957) Aug. 15.

The K^+ mesons produced in a liquid hydrogen target by the 1100-Mev bremsstrahlung of the synchrotron were measured at several laboratory energies and angles. The apparatus used is shown schematically and data are presented. (M.H.R.)

13406

PHOTOPRODUCTION OF K MESONS FROM POLYETHYLENE. A. B. Clegg, M. P. Ernstene, and A. V. Tollestrup (California Inst. of Tech., Pasadena). Phys. Rev. 107, 1200(1957) Aug. 15.

The photoproduction of K^+ mesons from polyethylene by 1.1-Bev bremsstrahlung from the synchrotron was studied by using a telescope of four scintillation counters. A value for the yield of K mesons at 37.5° in the laboratory was obtained and the τ-decay mode was distinguished from the rest of the main decay mode. Within experimental error, it is found in the same proportion to K_L decays as is found for K mesons produced in other reactions. (M.H.R.)

13407

PHOTOPRODUCTION OF PIONS AT COMPLEX NUCLEI. E. W. Laing and R. G. Moorhouse (Univ. of Glasgow). Proc. Phys. Soc. (London) A70, 629-38(1957) Sept.

The production of charged pions at complex nuclei is calculated on the basis of a simple independent particle model for the nucleus. The primary photoproduction is assumed to be a single nucleon process in which the struck nucleon undergoes transitions into discrete or continuum states. Two points of view are adopted, (a) that production may take place inside the nucleus; (b) that only surface production is allowed, according to the model of Wilson and of Butler. Cross sections are obtained for two nuclei, B^{11} and Ca^{40}. Available experimental data are inconsistent with surface production. (auth)

13408

ON THE SPINS AND DECAY INTERACTIONS OF $K_{\mu 3}$ AND K_{e3}. Susumu Furuichi, Tatsuro Kodama, Shuzo Ogawa, Yoshiko Sugahara, Akira Wakasa, and Minoru Yonezawa (Hiroshima Univ., Japan and Kanazawa Univ., Japan). Progr. Theoret. Phys. (Japan) 17, 89-106(1957) Jan.

The decay events $K_{\mu 3}$ and K_{e3} are investigated using the Lorentz invariance requirements as the restriction for the transition matrix, assuming that the weak Fermi interac-

tions are participating in the decays. Fermi interaction concerned is that realized among $\Lambda(\Sigma)$, N, μ(e), and ν. The study of the experimental data in the light of the analysis shows that K_{e3} seems to have spin 0 and the tensor type of Fermi interaction is necessary, while for $K_{\mu 3}$ no definite conclusion can be drawn at present. (auth)

13409

HYDRODYNAMICAL TREATMENT OF MULTIPLE MESON PRODUCTION IN HIGH ENERGY NUCLEON-NUCLEUS COLLISIONS. Saburo Amai (Kyoto Univ., Japan); Hiroshi Fukuda (Tokyo Inst. of Tech., Japan); and Chikashi Iso and Masatoma Sato (Tokyo Univ. of Education, Japan). Progr. Theoret. Phys. (Japan) 17, 241-87(1957) Feb.

The multiple meson production in high energy nucleon-nucleus collisions is treated by extending Landau's hydrodynamical model which is supported not only from experimental data on cosmic ray, but also from some theoretical point of view. As we have much data on the nucleon-nucleus collisions rather than on elementary collisions, we may get some clue to the future theory by comparing our results with the data on cosmic ray, though the latter are very complicated and our theory is somewhat phenomenological. Theoretical results are derived focusing on the dynamical properties of secondary particles, such as the effective inelasticity, energy and angular distributions and transverse momenta; and their dependence on the size of nucleus is considered. (auth)

13410

THE COUPLING CONSTANTS OF STRONG INTERACTIONS. Setsuko Miyachi (Osaka City Univ.). Progr. Theoret. Phys. (Japan) 17, 515-16(1957) Mar.

The order of magnitude of the coupling constants of strong interactions was estimated by perturbation methods. For this purpose the experimental data on the K^+-nucleon scattering, the π-proton scattering, and the strange particle production by π^--proton collision are used. (M.H.R.)

13411

PION-NUCLEON SCATTERING AND STRUCTURE OF FOURTH-ORDER MATRIX ELEMENTS IN Ps(Ps) MESON THEORY. Kugao Nakabayasi and Kazu Hasegawa (Tohoku Univ., Sendai). Progr. Theoret. Phys. (Japan) 17, 581-91 (1957) Apr.

The fourth-order S-matrix elements (ME) for elastic pion-nucleon scattering at low energies are analytically evaluated by expanding in powers of mass ratio μ/M, and are analyzed in detail so as to compare relative advantages of the theories. The scattering phase shifts are then evaluated using the variation principle for K-matrices. It is found that the main s-wave parts of the ME contain $\ln(M/\mu)$ term which has no bearing on the recoil effect and has the different sign for crossed and ladder graphs. In connection with this, the reason why the 5-box TD approximation gave essentially isotopic spin independent s-wave scattering is given. It is also suggested that the main recoil p-wave term $\ln(M/\mu)$ appearing only in the crossed graphs can be a possible reason why our $I = J = \frac{3}{2}$, p-wave phase shift does not show resonant behavior, contrary to that in the 5-box TD method as well as the Chew and Low theory. (auth)

13412

A KINEMATICAL TEST FOR THE RELATION BETWEEN THE COUPLING CONSTANTS IN MESON THEORY. Kichiro Hiida (Univ. of Hiroshima, Japan). Progr. Theoret. Phys. (Japan) 17, 605-7(1957) Apr.

METEOROLOGY

13413 AEC-tr-2932

CALCULATION OF VERTICAL VELOCITIES ACCORDING TO WIND FIELD DATA. (K Voprosu O Raschete Vertikal'nykh Skorostei Po Dannym Pol'a Vetra). E. M. Orlova. Translated from Met. Gidrol. I, 8-15(1955). 12p.

MOLECULAR PROPERTIES

13414

ON THE THEORY OF THE LIQUID He-4 PHASE TRANSFORMATION. Louis Goldstein (Los Alamos Scientific Lab., N. Mex.). Annals of Physics 2, 177-98(1957) Sept.

The previously obtained mean kinetic energy and kinetic heat capacity of saturated liquid He^4 around its phase transformation temperature will be used here in deriving some qualitative properties of the momentum space distribution function of the liquid atoms. The method will be first illustrated through a description of the local momentum space anomalies of ideal Bose-Einstein fluids which are responsible for their macroscopic first-order phase change. The derived liquid He^4 momentum space distribution functions will then be applied to predict, within the approximate formalism of the gas kinetic momentum transport mechanism, the qualitative temperature dependence of the viscosity coefficient around the transition temperature. Finally, modifications of various thermal properties of liquid He^4 around its transition temperature will be considered on the basis of a third-order type of phase change of liquid He^4, suggested by its recently observed very large, possibly infinite, heat capacity peak. (auth)

13415

THERMAL CONDUCTIVITY OF BERYLLIUM OXIDE FROM 40° TO 750°C. David A. Ditmars and Defoe C. Ginnings. J. Research Natl. Bur. Standards 59, 93-9 (1957) Aug.

The thermal conductivity of BeO has been measured by an absolute method from 40 to 750°C. The apparatus employed steady-state longitudinal heat flow along a rod of high-fired BeO, surrounded by a tube with matching temperature gradient to minimize radial heat loss. The estimated accuracy of the measurements is about 3%. However, the values of thermal conductivity of the ideal BeO crystal are probably considerably higher than the values given because of the lower density (87% theoretical) of the sample used. (auth)

13416

SOME INFRARED BANDS OF DEUTERIUM SULFIDE. Harry C. Allen, Jr., Earle K. Plyler, and L. R. Blaine. J. Research Natl. Bur. Standards 59, 211-14(1957) Sept.

Two regions of the D_2S spectrum have been observed, 5 and 3.6 μ. An analysis of the absorption in the 3.6 μ region attributes it to two overlapping bands with excited states $(v_1,v_2,v_3) = (1,1,0)$ and $(0,1,1)$. The band center of the (0,1,1) band is found to be some 50 cm^{-1} lower than the previously accepted value while the (1,1,0) band center is found some 60 cm^{-1} higher than the previous determination. The absorption near 5 μ seems to arise from the (0,0,1) band centered near 1906 cm^{-1}. Overlapping atmospheric absorption makes a detailed analysis impossible at this time. This band center is almost 100 cm^{-1} lower than previously reported. The excited state constants for the two bands near 3.6 μ are (1,1,0) $\nu_0 = 2742.77$ $A^* = 5.478$ $B^* = 4.512$ $C^* = 2.395$ and (0,1,1) $\nu_0 = 2754.44$ $A^* = 5.531$ $B^* = 4.521$ $C^* = 2.405$. (auth)

13417

VISCOSITY OF MIXTURES OF H_2 AND HD BETWEEN 300 AND 14 °K. A. O. Rietveld and A. Van Itterbeek. Physica 23, 838-42(1957) Sept.

The coefficients of viscosity of mixtures of hydrogen

and its isotope HD, as well as of the pure components, have been determined between 300 and 14°K, using the method of the oscillating disc. The measurements on the mixtures have been carried out as a function of the HD-concentration. The ratio $\eta HD/\eta H_2$ has been calculated. Below 70°K this ratio decreases. (auth)

13418

NONISOTHERMAL FLOW OF HELIUM II FILM. K. L. Chopra and J. B. Brown (Univ. of British Columbia, Vancouver). Phys. Rev. 107, 915-16(1957) Aug. 15.

The flow of helium II film is studied under conditions in which the temperature of the midpoint of the film can be changed in two ways. It is found that when cooling is effected by direct pumping on the film, flow is stopped with a cooling of about one millidegree. When cooling is by contact with a cold reservoir, however, there is no effect on the flow rate up to 40 millidegrees change. The film can thus flow through a temperature well. Further support is also given to the view that film transport rates are the same whether induced by gravitational or thermo-mechanical potential differences. (auth)

13419

ELASTIC CONSTANTS OF MAGNESIUM FROM 4.2°K TO 300°K. L. J. Slutsky and C. W. Garland (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 107, 972-6(1957) Aug. 15.

The adiabatic elastic constants of magnesium single crystals have been measured by an ultrasonic pulse technique. The values at 298°K are in good agreement with the recent values of Long and Smith. The values extrapolated to 0°K are $c_{11} = 0.635$, $c_{33} = 0.664$, $c_{44} = 0.1842$, $c_{12} = 0.259$, $c_{13} = 0.217$ in units of 10^{12} dynes/cm^2. A Debye characteristic temperature, θ, of 388 ± 3°K has been calculated at 0°K by averaging the inverse cube of longitudinal and transverse elastic wave velocities over all directions of propagation. Atomic force constants for a central-force model with an electron gas term are also obtained. (auth)

13420

A LATTICE MODEL OF LIQUID HELIUM. II. Hirotsugu Matsuda and Takeo Matsubara (Kyoto Univ., Japan). Progr. Theoret. Phys. (Japan) 17, 19-29(1957) Jan.

The partition function of the lattice model of liquid helium is calculated by making use of the Kikuchi's approximation. Setting two parameters, the effective mass $m = 1/7m_0$ (m_0 is the mass of He atom), and the lattice spacing d = 3.1 A, an excellent agreement of the density dependence of λ-temperature with experiment is obtained. The general trend of other thermodynamical quantities calculated is in good accordance with the observation. (auth)

13421

ON THE EFFECTIVE NORMAL FLUID DENSITY OF SOLUTION OF He^3 IN He^4. S. K. Trikha and V. S. Nanda (Univ. of Delhi, India). Progr. Theoret. Phys. (Japan) 17, 126-8(1957) Jan.

The effective "normal fluid" concentration in a 3.3% (by mass) solution of He^3 in He^4 was calculated on the basis of their model by making use of linear and quadratic expressions and using $\mu/m_3 = 2.17$, as required to explain the second sound velocity measurements in solutions. The results thus obtained are compared with various theories, using equations and the experimental results. A graph is given to show that this model describes the observed behavior better than other theories. (M.H.R.)

13422

THE SURFACE TENSION OF LIQUID He^3. S. K. Trikha and O. P. Rustgi (Univ. of Delhi, India). Progr. Theoret. Phys. (Japan) 17, 303-4(1957) Feb.

The surface tension of liquid He^3 is calculated as a function of temperature by using the equation, $\sigma = 2.35 \cdot P^{4/3}$ dyne cm^{-1}, and the data for density of liquid He^3 as determined recently by Kerr. (M.H.R.)

13423

THEORY OF THE SUSCEPTIBILITY AND SPECIFIC HEAT OF He^3. Sigeo Yomosa (Osaka Univ.). Progr. Theoret. Phys. (Japan) 17, 487-503(1957) Mar.

A gas model taking account of interatomic interactions is proposed for liquid He^3. Assuming that the interaction potential can be decomposed into Fourier components, $4\pi g(k)e^{ik\cdot r}$ (r: interatomic distance), the motion of the system is described using the method of Bohm and Pines. If the expansion coefficients $c_0, c_1, \ldots$ of g(k) in powers of k are regarded as parameters and suitable values of these parameters are presumed with reference to the value of sound velocity proposed by Mikura, the experimental data of nuclear susceptibility χ and specific heat C_V, it can be shown that the number of collective modes is of the order of one percent of the total degrees of freedom, so that the influence of the collective motion on χ and C_V is negligible in the vicinity of 0°K. The deviations of χ and C_V from those which follow from the simple free particles theory arise mainly from the exchange interactions. Considering only these exchange energies but neglecting the influence of the collective motion, the temperature dependence of χ in the whole temperature range can be explained provided that the k-dependence of the exchange energy per particle is accounted for, while the temperature dependence of C_V is explained only up to 0.3°K. (auth)

13424

VISCOSITY AND HEAT CONDUCTIVITY OF LIQUID He^3. S. K. Trikha (Delhi Univ., India). Progr. Theoret. Phys. (Japan) 17, 609-11(1957) Apr.

It is concluded that the reported temperature dependence of the viscosity of liquid He^3 resembles that of an ordinary liquid. An attempt is made to bring out this fact more clearly by an empirical approach which leads to the evaluation of viscosity and heat conductivity and an estimation of the zero-point energy of liquid He^3. (M.H.R.)

NEUTRONS

13425

MONTE CARLO CALCULATION OF THE SLOWING-DOWN TIME DISTRIBUTION FOR NEUTRONS IN HYDROGEN. George E. Haynam and Marshall F. Crouch (Case Inst. of Tech., Cleveland, Ohio). Nuclear Sci. and Eng. 2, 626-30 (1957) Sept.

The time required to slow neutrons down to various energies in a hydrogenous moderator is calculated by the Monte Carlo method. Exponential distributions are used for logarithmic energy loss and for distribution of free paths, and empirical cross section data are used to calculate the mean transit time between collisions at each energy. Results are presented in tabular form, and it is further shown that the distribution of slowing-down times at epithermal energies is well represented by a Pearson type III curve. Results of the calculation are compared with experimental results in an accompanying paper. (auth)

13426

EXPERIMENTAL MEASUREMENT OF THE SLOWING-DOWN TIME DISTRIBUTION FOR NEUTRONS IN WATER. Marshall F. Crouch (Case Inst. of Tech., Cleveland, Ohio). Nuclear Sci. and Eng. 2, 631-9(1957) Sept.

Fast neutrons are produced inside a H_2O moderator by a Po-α-Be source used effectively as a pulsed neutron source. The slowing-down time to the Cd edge is measured with a BF_3 proportional counter used with a Cd difference technique. The mean slowing-down time to 0.35 ev, and the variance thereof, are found to be 5.2 μsec and 8.0 μsec,

respectively. It is shown that this is in reasonable agreement with the results of a Monte Carlo calculation, provided collisions are considered to involve whole H_2O molecules when the neutron energy falls below about 1.6 ev. (auth)

13427

SLOWING DOWN AGE OF NEUTRONS FROM A Ra-α-Be SOURCE TO INDIUM RESONANCE IN ALUMINUM LIGHT WATER MIXTURES. V. P. Duggal and S. M. Puri (Atomic Energy Establishment, Trombay, Bombay). Proc. Indian Acad. Sci. 46, 72-9(1957) July.

Using a Ra-α-Be source, an experiment was performed to determine the value of Fermi age $\tau = \frac{1}{6}\overline{r^2}$ up to In resonance for pure H_2O and four Al$-H_2O$ mixtures, the volume ratios being 1:1, 2:3, 1:2 and 1:4 for the four samples. Theoretical values of τ were also computed taking into account the effects of anisotropy in elastic scattering in O and Al and inelastic scattering in Al. (auth)

13428

THE MEASUREMENT OF FAST NEUTRON FLUX OVER THE NEUTRON ENERGY RANGE 0.03 Mev TO 3.0 Mev. W. D. Allen and A. T. G. Ferguson (Atomic Energy Research Establishment, Harwell, Berks). Proc. Phys. Soc. (London) A70, 639-53(1957) Sept.

Measurements of neutron flux in the energy region 0.03 to 3.0 Mev were made using a proton recoil counter and a Hanson–McKibben type long counter. Several proton recoil counters filled with different gases at different pressures gave flux measurements self-consistent to 2%. The long counter was calibrated against photoneutron sources at a number of energies and also against the recoil counter. The variation of its efficiency as determined by the two methods is in satisfactory agreement. The absolute calibration of the long counter with respect to a RdTh$-D_2O$ source whose strength was known to $\pm 2\frac{1}{2}\%$ agreed with the calibration with respect to the recoil counter to 1%. A similar cross check with an Ra–Be source gave an initial discrepancy of 15% but this was traced to an error in the source strength and variation with energy in the response of the long counter. These cross checks are satisfactory and over the major portion of the energy range the standard error is not more than ±3%. (auth)

13429

RETARDING OF FAST NEUTRONS IN MEDIA OF HIGH ATOMIC NUMBER. Hans-Wilhelm Schmidt. Z. Physik 148, 128-34(1957). (In German)

The energy distribution of fast neutrons in media of high atomic number is computed under the assumption that the energy loss is caused only through inelastic scattering. Results are reported for an experimental energy distribution of primary neutrons and for a monochromatic source. For the calculation, the one dimensional transport equation is used. (tr-auth)

NUCLEAR PHYSICS

13430 IDO-16394

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

QUARTERLY PROGRESS REPORT FOR MTR TECHNICAL BRANCHES, SECOND QUARTER, 1957. J. E. Evans, ed. Aug. 22, 1957. 62p. Contract AT(10-1)-205. $1.75(OTS).

The Engineering Test Reactor Critical Facility was taken to criticality with 22 fuel elements and 5 control-fuel sections. Preliminary flux mapping has been accomplished. The gross temperature coefficient was measured to be -2.3×10^{-5} $\Delta k/k$ per °F in the temperature range from 75 to 100°F. The average worth of the gray shim rods is about 1% in $\Delta k/k$. Details of the control system and of the control rod magnet design are given. Calibration measurements on the RMF oscillator have been made with samples of Y_2O_3. A detailed study on the calculation of MTR fuel loads is presented and a method for calculating the ETR charge life from ETR Critical Facility data has been developed. Hydraulic and static tests have been made on ETR fuel elements. The flat plate ETR elements have greater deflections at all pressure differentials than MTR elements. Additional developmental work is being done on an MTR shim rod which will have renewable fuel and poison sections. Feasibility studies for an In gamma facility have included corrosion tests and a nearly full scale indium sulfate irradiation experiment in the RMF. SPERT I calculation procedures are being modified in the light of experimental measurements and will be applied to the new core which has fuel assemblies with removable fuel plates. The critical size calculations for SPERT III have been modified to include the effects of several thermal shields and filler pieces. Two and three group critical size calculations for SPERT III have been compared. An exploratory experiment was performed on the RMF with Pu napkin ring samples to measure the fission product transient behavior of Pu. A measurement shows that the number of delayed neutrons per fission in U^{233} are approximately the same for fissions produced by thermal neutrons and those produced by epi-Ca neutrons. The major emphasis of the cross section program has been on the fission and total cross section of U^{233}, the application of the Wigner-Eisenbud multilevel formalism to fitting these U^{233} fission data, and the total cross section and resonance parameter determinations for Pu^{239}, Pu^{240}, Y, Sr, and for several isotopes with atomic numbers near 150; such as Sm^{147}, Sm^{149}, Te^{123}, Te^{125}, Nd^{143}, and Nd^{145}. The 1024 channel analyzer including an IBM 523 reproducing punch for the readout of data has been put into operation on the fast chopper. With the 1024 channels, total cross section data for a sample can be obtained from 0.02 to 1 ev in a single run in about 5 hours. An improved detector delay system has been built for fast chopper detector systems. In nuclear chemistry work is under way on several second order capture cross sections and progress was made in developing techniques for thermal and resonance flux monitoring, and for the determination of resonance integrals. In the decay scheme program, studies on the efficiencies of 3″ × 3″ NaI crystals have been continued. The decay scheme of 4.5 hour Ru^{106} has been improved by gamma spectra measurements. (For preceding period see IDO-16373.) (auth)

13431 UCRL-3796(Rev.)

California. Univ., Berkeley. Radiation Lab.

POLARIZATION AND ANGULAR CORRELATION IN THE PRODUCTION AND DECAY OF PARTICLES OF SPIN $\frac{1}{2}$ AND SPIN $\frac{3}{2}$. Richard Spitzer and Henry P. Stapp. July 1957. 71p. Contract W-7405-eng-48. $12.30(ph OTS); $4.50(mf OTS).

A general formalism describing the angular correlation and polarization effects in the production and subsequent decay of particles of arbitrary spins was developed. It has been specialized to the cases of production and decay of particles of spin $\frac{1}{2}$ and $\frac{3}{2}$. Expressions for the angular distribution and polarization of the decay products were reduced to tractable forms involving the physical vectors of the problem and a minimal number of parameters describing the production and decay interactions. The results are discussed for two particular production processes in order to determine what information on the spin of the hyperon and the production and decay mechanisms may be obtained from the analysis of the decay products. (auth)

13432

PHENOMENOLOGICAL NEUTRON–PROTON POTENTIALS. Roger G. Newton (Indiana Univ., Bloomington) and Thomas Fulton (John Hopkins Univ., Baltimore, Md.). Phys. Rev. 107, 1103-11(1957) Aug. 15.

Central, tensor, and spin-orbit potentials are calculated for the neutron-proton triplet state. They allow explicit solution of the Schrödinger equation and fit the low-energy data: effective range, scattering length, deuteron binding energy, quadrupole moment, and D-state probability. The deuteron wave function as well as scattering wave functions which result from these potentials are also computed. The potential and wave functions which fit the low-energy singlet state data are also obtained. (auth)

13433

NEUTRINO PHYSICS. Frederick Reines and Clyde L. Cowan, Jr. (Los Alamos Scientific Lab., N. Mex.). Phys. Today 10, No. 8, 12-18(1957) Aug.

Developments in neutrino physics are summarized, from Paulis' hypothesis in 1930 through the experiments illustrating nonconservation of parity in 1957. (M.H.R.)

13434

A METHOD OF RENORMALIZATION FOR UNSTABLE PARTICLES. Takao Okabayashi and Shigeo Sato (Univ. of Tokyo, Japan). Progr. Theoret. Phys. (Japan) 17, 30-42 (1957) Jan.

Lee's model, modified in such a way that the V state is in the unstable mass relation, is investigated. A renormalization procedure is proposed which reduces to the conventional one in the stable case but is essentially different from the latter in some respects. The result obtained by this method shows the instability of the V state. However, its decay character is more complicated than the ordinarily accepted exponential time-dependence. Some new features introduced are discussed. (auth)

13435

RELATION BETWEEN THE NUCLEAR COLLECTIVE MODEL AND THE INDIVIDUAL PARTICLE MODEL WITH CONFIGURATIONAL MIXING. Satio Hayakawa and Toshio Marumori (Kyoto Univ., Japan). Progr. Theoret. Phys. (Japan) 17, 43-62(1957) Jan.

By using the method of the quantum mechanical description of collective motion, the relation between the collective model and the individual particle model with configurational mixing is discussed on the basis of the postulates: The wave function of the nucleus, as a system composed of actual nucleons, implies strong correlations, so that the Hartree approximation makes little sense. Consequently, the method of configurational mixing currently employed as well as the shell model may not be usable without altering the representation. The strong correlation gives rise to collective motion, chiefly the surface oscillation at low energies. The individual motion of nucleons which remains after subtraction of the collective motion is only weakly correlated, so that the shell model is a good approximation to the individual motion. Leaving aside the essential problem of proving this statement, the following conclusions, are reached concerning the relationship between the collective and the shell models of nuclei. The individual particle model with configurational mixing does in fact hold in the case of small nuclear deformation, provided that the individual particle motion in the collective representation can be treated by means of the adiabatic approximation. The effective inter-particle force responsible for the configurational mixing consists of the following two parts, one arising from the exchange of surfons between an extra-particle and a particle in the core and the other arising from a direct inter-particle interaction. As far as the quadrupole moment is concerned, the collective model and the method of configurational mixing do not show any essential difference. However, there exists an essential difference in these two methods for the interpretation of the magnetic moments. (auth)

13436

ON THE EXCHANGE EFFECT IN THE STRIPPING REACTIONS. T. Kammuri, R. Nakasima, and S. Takagi (Osaka Univ., Japan). Progr. Theoret. Phys. (Japan) 17, 306-7(1957) Feb.

The possibility of the heavy particle stripping mechanism is examined taking into account the effect of nucleon exchange. The (d,n) reactions are taken for an illustration and the exchange phenomena between the neutron which initially composes the deuteron and those which are in the outer orbits of the target nucleus are considered by properly symmetrizing the wave function of the total system. (M.H.R.)

13437

AN ATTEMPT OF GENERALIZING THE HYPOTHESIS OF CHARGE INDEPENDENCE. I. SELECTION RULE FOR THE DECAY PROCESS. Osamu Hara and Yasunori Fujii (Nagoya Univ.). Progr. Theoret. Phys. (Japan) 17, 313-25 (1957) Mar.

An attempt is made to generalize the hypothesis of charge independence to the weak interaction. The fundamental assumption is that the strangeness quantum number is not a scalar but the third component of an angular momentum vector in the charge space, and the sum of this new vector and the usual isotopic spin is conserved in all processes. The case when the usual charge independence holds is assumed to correspond to the special case when these two vectors are conserved separately. It is shown that this assumption leads, when combined with the composite hypothesis proposed by Markov and Sakata, to a consistent level scheme for hyperons and heavy mesons, and moreover gives a new selection rule for the decay process which is essentially equivalent to $|\Delta I| = \frac{1}{2}$ recently suggested by many authors. It gives also other results which can be compared with experiments directly. Among them a preliminary discussion is given on a new selection rule expected in the annihilation of nucleon-antinucleon pairs. A comment on the b-field proposed by Yang and Mills is also given. (auth)

13438

PION THEORY OF THREE-BODY FORCES. Jun-ichi Fujita and Hironari Miyazawa (Univ. of Tokyo). Progr. Theoret. Phys. (Japan) 17, 360-5(1957) Mar.

Three-body forces among three nucleons are calculated on the basis of the static pion theory. It is assumed that only one pion each is exchanged between nucleon (1) and (2), and between (2) and (3), although any number of pions may be emitted and absorbed by the same nucleon. The validity of this calculation is therefore limited to the case when every nucleon is well separated from the other. This three-body potential has a contribution of about 0.22 Mev to the triton binding. In a heavy nucleus the binding energy due to this potential is attractive and about 10% of that due to two-body interaction. This effect can be roughly stated as follows. Within a nuclear matter the potential between two nucleons takes a different shape due to many body forces. The depth is increased by 9% and the range is decreased by 13%. (auth)

13439

THE HEXADECAPOLE MOMENTS OF ATOMIC NUCLEI. Shôta Suekane and Yoshio Yamaguchi (Osaka City Univ.). Progr. Theoret. Phys. (Japan) 17, 449-60(1957) Mar.

The electric hexadecapole moments $Q^{(4)}$ of atomic nuclei are investigated on the basis of three nuclear models, i.e., shell, liquid drop, and collective models.

The effect of the deformed core on this higher moment is discussed in detail. It is shown that experimental values of $Q^{(4)}$ shell be used to test the validity of the collective model (Bohr-Mottelson's theory), and the core part of $Q^{(4)}$ is useful to derive information about the core deformation of order 4. (auth)

13440

QUANTUM NUMBERS FOR LEPTON PROCESSES. Yasuhisa Katayama (Kyoto Univ.). Progr. Theoret. Phys. (Japan) 17, 510-11(1957) Mar.

13441

ON A CLASSIFICATION OF LIGHT PARTICLES. Kei Senba (Hiroshima Univ.). Progr. Theoret. Phys. (Japan) 17, 519-20(1957) Mar.

A scheme for classifying the lepton family without introducing the charge independence hypothesis is given. For this purpose the n_e-charge is introduced into leptons in an analogous manner to the Nishijima model, in addition to the lepton number conversion proposed by Konopinski-Mahmoud. Then, there should be an intimate relationship between the charge Q and n_e-charge for each particle. (M.H.R.)

13442

THE CATALYSIS OF NUCLEAR FUSION REACTIONS BY μ^--MESONS Chushiro Hayashi and Minoru Nishida (Kyoto Univ., Japan) and Tadao Nakano, Shota Suekane, and Yoshio Yamaguchi (Osaka City Univ., Japan). Progr. Theoret. Phys. (Japan) 17, 615-17(1957) Apr.

Events were observed previously in which a μ^- meson comes to rest in hydrogen to form a μ^--mesic atom, which then ejects the meson with kinetic energy of 5.4 Mev. An attempt is made to explain these events and show that calculated results agree semiquantitatively with the experimental data (M.H.R.)

NUCLEAR PROPERTIES

13443 KAPL-1781

Atomic Energy of Canada Ltd. [Chalk River Project], Chalk River, Ont. and Knolls Atomic Power Lab., Schenectady, N. Y.

REVIEW OF THE JOINT AECL-KAPL STUDIES OF THE TRANSURANIUM ELEMENTS. J. P. Butler, T. A. Eastwood, H. G. Jackson, T. L. Collins, M. E. Jones, F. M. Rourke, and R. P. Schuman. July 2, 1957. 40p. Contract W-31-109-Eng-52. $1.00(OTS).

The Research Chemistry branch of Atomic Energy of Canada, Limited, and the Research Operation of the Knolls Atomic Power Laboratory have made a joint nuclear study of the transuranium elements produced by the long-term irradiation of Pu in the Materials Testing Reactor. This report reviews the joint program and includes a brief mention of both published and unpublished results. Data are given on Pu^{238}, Pu^{240}, Pu^{241}, Pu^{242}, Pu^{243}, Pu^{244}, Pu^{245}, Am^{243}, Am^{245}, Cm^{243}, Cm^{244}, Cm^{245}, Cm^{246}, Cm^{247}, Cm^{248}, Cm^{249}, Bk^{249}, Cf^{249}, Cf^{250}, Cf^{251}, Cf^{252}, Cf^{253}, Es^{253}, Es^{254}, Es^{254m}, Es^{255}, Fm^{254}, and Fm^{255}. (auth)

13444 TPI-87

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

ESTIMATED FISSION FRAGMENT MASSES. I. W. Hay and T. D. Newton. July 1956. 156p.

The mass excesses, M-A, of atoms in the fission fragment region have been empirically estimated by extrapolation of β-decay Q-values using the regularities found by Way and Wood (1954). The resulting estimates of the energy release in fission may indicate the most probable charge and, roughly, the range of charge for a given mass ratio of primary fission fragments. (auth)

13445

AN INVESTIGATION OF THE DECAY SCHEME OF Ta^{182} BY MEANS OF A COINCIDENCE SCINTILLATION SPECTROMETER. Per Olof Fröman and Hans Ryde (Univ. of Lund, Sweden). Arkiv Fysik 12, 399-413(1957).

The level scheme of W^{182} proposed by Murray et al. and refined by Alaga et al. is in its essential features confirmed by means of coincidence experiments. Gamma ray intensities differing somewhat from those by Murray et al. are also obtained. (auth)

13446

NUCLEAR ENERGY LEVELS AND MULTIPOLE TRANSITIONS IN THE LEAD REGION. PART I. I. Bergström and G. Andersson (Nobel Inst. of Physics, Stockholm and Gustaf Werner Inst. for Nuclear Chemistry, Uppsala). Arkiv Fysik 12, 415-79(1957).

A compilation was made of experimental data concerning energy levels of nuclei in the Z-region 77-84. The data include spin, parity and lifetime of the levels as well as energy and conversion ratios of the multipole transitions involved in their de-excitation. K/L and $(L_I + L_{II})/L_{III}$ conversion ratios are found to agree reasonably well with the values obtained from Rose's tables. Regularities in level separations are pointed out and the appearance of certain levels is discussed on the basis of single-particle shell model predictions. A comparison is made between experimentally determined γ-transition probabilities for E2, E3, E4, E5, and M4 transitions and those calculated from single-particle theory. A marked influence of the magic numbers Z = 82 and N = 126 shows up both in level separations and in transition probabilities. Special attention is payed to the present theoretical and experimental knowledge of levels in nuclei in the immediate neighborhood of the double magic Pb^{208}. (auth)

13447

ALPHA DECAY OF DEFORMED NUCLEI. Per Olof Fröman (Univ. of Copenhagen, Denmark). Kgl. Danske Videnskab. Selskab Mat. Fys. Skrifter 1, No. 3, 1-76 (1957).

The problem of the alpha fine structure intensities for deformed nuclei is treated on the basis of the unified nuclear model. A system of coupled differential equations for the radial wave functions is obtained; they correspond to the different channels into which the alpha particle is able to leak out, leaving the daughter nucleus in different final states. An approximate analytical formula is derived for the intensities of the different alpha groups in terms of the alpha wave function on the nuclear surface. Also an analysis of the empirical data is presented. The nuclear deformation causes the alpha decay rate to be enhanced by a factor which increases slowly with the nuclear deformation and which may amount to about 2 for the largest deformations actually found. However, an enhancement factor of this kind is difficult to detect experimentally. The empirical intensities of the even parity alpha groups of even-even nuclei indicate the existence of higher multipole deformations of even parity in the nuclear surface. The magnitudes of these higher order deformations may change rapidly with the atomic number Z. From the empirical intensities of the odd parity alpha groups which have been found in some even-even nuclei, an estimate is presented of the magnitude of the nuclear octupole moment, the existence of which has been suggested by Christy to explain the presence of the odd parity alpha groups for these even-even nuclei. The favoured alpha decays of odd-A nuclei and even-even nuclei are similar, and it is possible to obtain an approximate formula which relates the intensities of the favoured alpha groups of an odd-A nucleus to the intensities of the alpha groups of neighbouring even-even nuclei. This intensity formula

which was first given in a recent paper by Bohr, Fröman, and Mottelson is discussed in greater detail. The angular distributions of alpha particles from polarized nuclei are also considered. (auth)

13448

MULTICHANNEL ANGULAR CORRELATION MEASUREMENT OF GAMMA RAYS FROM DISINTEGRATION OF Ag^{110m} AND SPIN ASSIGNMENT OF EXCITED LEVELS OF Cd^{110}. Mitsuo Sakai, Haruko Ohmura, and Teruo Momota (Univ. of Tokyo, Japan). J. Phys. Soc. Japan 12, 985-93(1957) Sept.

The angular correlation of gamma rays from the disintegration of Ag^{110} has been studied with scintillation spectrometers. Ten correlation functions were measured by taking advantage of multichannel characteristic of a twenty-channel pulse height analyzer. The spin values of Cd^{110} in 2.93, 2.48, and 1.54-Mev excited states were found to be 3−, 2+ and 2± respectively and the radiation characteristic of three gamma rays of energies 0.885, 0.935 and 1.390-Mev were also determined. (auth)

13449

ON THE DECAY OF ^{48}Sc AND ^{48}V. B. Van Nooijen, J. Konijn, A. Heyligers, J. F. Van der Brugge, and A. H. Wapstra. Physica 23, 753-66(1957) Aug.

The spin assignments of the known levels in Ti^{48} excited in the decay of Sc^{48} and V^{48} have been checked by angular correlation and conversion coefficient measurements. The spin and parity of the 3.24 Mev level were uniquely determined as 4^+. The γ-ray energies were found to be 986 ± 3 (γ_1), 1040 ± 3 (γ_2), 1314 ± 4 (γ_3), and 2253 ± 15 (γ_4) kev, the end points of the negatron and positron spectra in Sc^{48} and V^{48} 654 ± 7 and 698 ± 4 kev and the decay energies of these nuclides 3994 ± 9 and 4020 ± 7 kev respectively. The intensity of a possible 940 kev γ ray suggested by earlier coincidence measurements is found to be smaller than 5%. Positron decay occurs in (55.6 ± 0.8) % of the V^{48} transitions; this value is in agreement with theoretical predictions by Zweifel if no 940 kev γ ray occurs. The half life of V^{48} was measured as 16.15 ± 0.17 days. (auth)

13450

NUCLEAR SPIN RELAXATION IN HYDROGEN. III. THE SOLID NEAR THE MELTING POINT. Myer Bloom. Physica 23, 767-80(1957) Aug.

The longitudinal and transverse relaxation times t_1 and t_2 have been measured at 30 MHz using the pulse method for the proton magnetic resonances in solid H_2 and HD in the region near the melting point where appreciable self-diffusion takes place. The $\log t_2$ versus 1/T plots are linear for both solids over a wide range of temperatures, indicating that the coefficients of self-diffusion may be written in the form $D_0 \exp(-E_a/Rt)$. The values of E_a obtained for H_2 and HD are 380 ± 20 calorie/mole and 600 ± 40 calorie/mole respectively, while the approximate values obtained for D_0 are 10^{-3} cm^2/sec and 0.1 cm^2/sec respectively. t_1 in H_2 is caused by the effect of reorientations of the ortho-H_2 molecules, and is found to be roughly temperature independent at 0.22 second, in agreement with the theory of Moriya and Motizuki. t_1 in HD is caused by the presence of a small amount of H_2 impurity. A quantitative interpretation of the effect of the H_2 impurity shows that the activation energy for diffusion of H_2 in HD is approximately the same as in H_2 and that $D_0 \simeq 10^{-4}$ cm^2/sec. (auth)

13451

FORMATION AND PROPERTIES OF SELENIUM 71. A. H. W. Aten, Jr. and A. C. Pieterse. Physica 23, 799-800(1957) Aug.

13452

PARITY AND ELECTRON POLARIZATION: Au^{198}. H. Frauenfelder, R. Bobone, E. von Goeler, N. Levine, H. R. Lewis, Jr., R. N. Peacock, A. Rossi, and G. DePasquali (Univ. of Illinois, Urbana). Phys. Rev. 107, 909-10(1957) Aug. 1.

13453

PARITY AND ELECTRON POLARIZATION: 0 → 0 TRANSITION IN Ga^{66}. H. Frauenfelder, A. O. Hanson, N. Levine, A. Rossi, and G. DePasquali (Univ. of Illinois, Urbana). Phys. Rev. 107, 910-11(1957) Aug. 1.

13454

RELATION OF THE DEUTERON PHOTODISINTEGRATION CROSS SECTION TO THE NEUTRON-PROTON FORCE. Roger G. Newton (Indiana Univ., Bloomington). Phys. Rev. 107, 1025-7(1957) Aug. 15.

It is shown that for a very general class of neutron-proton triplet S-phase shifts, given as functions of the energy, the experimental deuteron photodisintegration cross section singles out the neutron-proton central triplet potential with the shortest exponential tail. It is therefore powerful evidence for a short decay length of this potential evidence which is unobtainable from the low-energy scattering data and the binding energy alone. (auth)

13455

DECAY OF MOLYBDENUM-91. J. D. Prentice and K. G. McNeill (The Univ., Glasgow, Scotland). Phys. Rev. 107, 1041-3(1957) Aug. 15.

A study has been made of the radioactivity of Mo^{91} and Mo^{91m}, produced by x-irradiation of natural Mo, in order to clarify the decay scheme of this isotope. The γ-ray spectrum was measured using scintillation spectrometers and coincidence circuits. Three γ rays which had a half life of 64 seconds were found at 1.50, 1.20, and 0.65 Mev. The first two were in coincidence with positrons but not with each other, while the 0.65-Mev γ ray was not in coincidence with positrons or with the two other gamma rays. The intensities of the γ rays were in the ratios 1.5 Mev : 1.2 Mev : 0.65 Mev = 39 : 39 : 100. By using a plastic scintillator, positrons from the ground state of Mo^{91} (15 minute half life) were found to have an end-point energy of 3.3 Mev while two positron groups from the isomeric state were found with energies differing by 0.2 ± 0.1 Mev. On the available evidence a decay scheme is suggested. (auth)

13456

DELAYED NEUTRONS FROM FISSIONABLE ISOTOPES OF URANIUM, PLUTONIUM, AND THORIUM. G. R. Keepin, T. F. Wimett, and R. K. Zeigler (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 107, 1044-9(1957) Aug. 15.

The periods, relative abundances, and absolute yields of delayed neutrons from "fast" fission of six nuclides (U^{235}, U^{233}, U^{238}, Pu^{239}, Pu^{240}, and Th^{232}) and thermal fission of three nuclides (U^{235}, U^{233}, and Pu^{239}) have been measured. "Godiva," the bare U^{235} metal assembly at Los Alamos, was the neutron source. Six exponential periods were found necessary and sufficient for optimum least-squares fit to the data. Despite evident perturbations, general agreement among delayed-neutron periods was obtained for all nuclides. The absolute total delayed-neutron yield for each nuclide has been measured for fast and thermal fission; a spectral effect was not observed. These data have been corroborated in detail by independent period-vs-reactivity measurements on the bare U^{235} assembly. A comparison of the present results with a phenomenological theory of delayed-neutron emission has been made. This treatment has lead to the prediction of several new short-period delayed-neutron precursors. (auth)

13457

RADIOACTIVE Ge^{77} AND Ge^{77m}. W. S. Lyon and J. S. Eldridge (Oak Ridge National Lab., Tenn.). Phys. Rev. 107, 1056-7(1957) Aug. 15.

Pile neutron activation cross sections for production of Ge^{77} and Ge^{77m} have been obtained. In addition, the half lives of Ge^{77} and Ge^{77m} have been measured as well as the γ/β^- branching in the beta decay of Ge^{77m}. (auth)

13458

RATIO OF L/K X-RAY INTENSITIES IN THALLIUM-204 DECAY. Henry Schmied and Richard W. Fink (Univ. of Arkansas, Fayetteville). Phys. Rev. 107, 1062-4(1957) Aug. 15.

The ratio of L and K x-rays of Hg resulting from orbital-electron capture in high-specific-activity sources of 4-year Tl^{204} has been measured with a gas proportional counter and NaI(Tl) scintillation spectrometer. The intensity ratio was found to be $I_L/I_K = 0.46 \pm 0.04$. If one accepts a value of 0.524 for the L/K electron capture ratio from the theoretical results of Brysk and Rose, the mean L-fluorescence yield of Hg becomes $\bar{\omega}_L = 0.34 \pm 0.04$. A study was made of the possible effect of fluorescent x-ray excitation owing to the noncarrier-free nature of the source; among sources of equal radioactive strength ranging in superficial density from 0.54 to 2.21 mg/cm^2 in inert thallium nitrate solids, no appreciable change in the x-ray intensities was detected. (auth)

13459

ANGULAR DISTRIBUTIONS OF SCATTERED NEUTRONS. A. Langsdorf, Jr., R. O. Lane, and J. E. Monahan (Argonne National Lab., Lemont, Ill.). Phys. Rev. 107, 1077-87 (1957) Aug. 15.

The angular distribution of neutrons scattered from 36 elements and one compound has been measured over the energy interval 60 to 1800 kev. The results are presented in terms of the coefficients of a Legendre-polynomial expansion of the differential scattering cross section in the laboratory coordinate system. All of the data have been corrected for attenuation of the primary beam and a representative part of the data has been corrected for multiple scattering and for the finite angular resolution of the experimental equipment. The analytical details of the multiple (essentially, double) scattering corrections are given in an appendix. (auth)

13460

SPONTANEOUS-FISSION HALF-LIVES OF Cf^{254} AND Cm^{250}. J. R. Huizenga and H. Diamond (Argonne National Lab., Lemont, Ill.). Phys. Rev. 107, 1087-90(1957) Aug. 15.

Lease-squares analysis of spontaneous-fission data obtained over the last four years from a californium sample produced in the November 1952 thermonuclear test gives a Cf^{254} spontaneous-fission half life of 56.2 ± 0.7 days in agreement with the astrophysical value of 55 ± 1 days. Some comments are made on the neutron buildup in Type I supernovae and the influence of a possible double magic number, N = 184, Z = 82, at A = 266 on the yield curve near A = 254. An approximate spontaneous-fission half-life of 2×10^4 years for Cm^{250} is deduced from a curium sample also produced in the November, 1952 thermonuclear test. (auth)

13461

ODD-PARITY ROTATIONAL BANDS IN EVEN-EVEN NUCLEI. F. S. Stephens, Jr., Frank Asaro, and I. Perlman (Univ. of California, Berkeley). Phys. Rev. 107, 1091-4(1957) Aug. 15.

The low-intensity radiations accompanying the α decay of Th^{230} and Th^{228} have been studied with a scintillation and coincidence spectrometer. In addition, the α-particle spectrum of Th^{228} has been re-examined using a magnetic spectrograph. New γ rays of 253 kev (8×10^{-4}%), 110 kev (1×10^{-4}%), 206 kev (5×10^{-6}%), and 235 kev (5×10^{-6}%) have been found associated with Th^{230} decay. A new γ ray of 205 kev (0.03%) has been found in Th^{228} decay, and also a fifth α group populating a level 289 kev above the ground state was observed in an abundance of 0.03%. A new level at 416 kev in Ra^{226} suggested by these data and the coincidence measurements has been interpreted as the 6+ member of the ground-state rotational band. The remaining new levels have been assigned as 3– and 5– members of rotational bands based on the 1– states previously observed in both Ra^{226} and Ra^{224}. (auth)

13462

CALCULATIONS OF THE ENERGY LEVELS IN DEFORMED NUCLEI. Kailash Kumar and M. A. Preston (McMaster Univ., Hamilton, Can.). Phys. Rev. 107, 1099-1103(1957) Aug. 15.

The methods of calculating the energy levels in spheroidal nuclei are discussed. It is shown that the expansion of the perturbation in powers of the deformation parameter, β, leads to a very slowly convergent series representation of the matrix elements. An alternative method of expressing the perturbation, due to Moszkowski, which can allow a better calculation, is also discussed. (auth)

13463

CROSS SECTIONS OF NUCLEI FOR HIGH-ENERGY PIONS. J. W. Cronin, R. Cool, and A. Abashian (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 107, 1121-30(1957) Aug. 15.

Measurements of the diffraction and absorption cross sections of nuclei for negative pions at kinetic energies between 0.6 and 1.4 Bev are described. They include the absorption cross section (1) in selected nuclei from Be to Pb at 0.97 Bev, (2) in C between 0.6 and 1.2 Bev, and (3) in Al, Ca, and Pb for 1.5-Bev/c momentum π^- and protons. Diffraction cross sections were obtained for (1) Be, C, Al, and Ca at 0.97 Bev and (2) C at 0.6, 0.8, and 1.2 Bev. The data are compared to the optical model of the nucleus. Detailed computations are described both for a tapered Fermi-type distribution of nucleons which fits the high-energy electron scattering data and for a uniform square-well nucleon distribution of the form $R = r_0 A^{1/3}$. All of the absorption cross sections are shown to be in excellent agreement for a Fermi distribution with a single radial parameter $c = (1.14 \pm 0.04)A^{1/3} \times 10^{-13}$ cm, which is 6% larger than that required by electromagnetic measurements. The data are also consistent with the same value of the radial parameter as that which fits the electron-scattering data if the range of the pion-nucleon force is taken to be $\approx 1.0 \times 10^{-13}$ cm. This range is equal to the range required by pion-nucleon scattering data. A uniform distribution $R = r_0 A^{1/3}$ is not consistent with the data. The diffraction cross sections appear to be 20–30% higher than those predicted by the optical model and the dispersion relations. The implications of this discrepancy are discussed. (auth)

13464

α^3 CORRECTIONS TO THE HYPERFINE STRUCTURE OF THE 1S AND 2S STATES OF HYDROGEN. Marvin H. Mittleman (Univ. of California, Livermore). Phys. Rev. 107, 1170-80(1957) Aug. 15.

Recent precision measurements of the hyperfine splitting in the 1S and 2S states in hydrogen would make possible the observation of α^3 corrections. A calculation of these corrections would be difficult because of the many processes that can contribute to this order and because of the uncertainty of the nuclear structure effects that can contribute in this numerical order. For these reasons only the ratio of the hyperfine structure in the 2S state to that in the 1S

state is calculated here. It is shown that the formation of the ratio eliminates the contribution of most of the α^3 corrections and totally eliminates the nuclear structure effects. The coefficient, B−A, of the α^3 terms in the ratio is calculated as (B−A) = 5.28. This compares with the experimental value, $(B-A)_{exp} = 3.4 \pm 0.8$. (auth)

13465

COLLECTIVE EFFECTS IN O^{17}. B. James Raz (Argonne National Lab., Lemont, Ill.). Phys. Rev. 107, 1201-3(1957) Aug. 15.

The short lifetime of the first excited state of O^{17} at 0.872 Mev is accounted for by the introduction of small collective effects. (M.H.R.)

13466

MAGNETIC MOMENT OF Ne^{21}. J. T. LaTourrette, W. E. Quinn, and N. F. Ramsey (Harvard Univ., Cambridge, Mass.). Phys. Rev. 107, 1202(1957) Aug. 15.

13467

β-γ CIRCULAR POLARIZATION CORRELATION IN A J-J TRANSITION. F. Boehm and A. H. Wapstra (California Inst. of Tech., Pasadena). Phys. Rev. 107, 1202-3(1957) Aug. 15.

The study of β-γ circular polarization correlation in β transitions without spin change provides valuable information about β-decay coupling constants. Work on Co^{58} seems to indicate the absence of interference terms. In order to study this problem with a difference approach and β emitter, Sc^{46} was measured by the method previously used. (M.H.R.)

13468

THE RADIATIVE CAPTURE OF ALPHA PARTICLES IN ^{15}N. P. C. Price (Cavendish Lab., Cambridge). Proc. Phys. Soc. (London) A70, 661-7(1957) Sept.

The $N^{15}(\alpha,\gamma)F^{19}$ reaction was examined with α energy from 1.2 to 2.35 Mev. Three resonances were found, two narrow and one of measurable width. The cascade schemes at each of the resonances were partly elucidated, and the partial radiative widths of the resonances were determined, except for a statistical factor. Some of the angular distributions were measured, and conclusions were drawn about the possible values of the spins and parities of the levels concerned. The relation of these results to the predictions of Elliott and Flowers is briefly discussed. (auth)

13469

HYPERFINE STRUCTURE AND NUCLEAR ELECTRIC QUADRUPOLE MOMENT OF ^{17}O. R. A. Kamper, K. R. Lea, and C. D. Lustig (Clarendon Lab., Oxford). Proc. Phys. Soc. (London) B70, 897-9(1957) Sept.

The hyperfine structure of free O^{17} atoms was measured in a paramagnetic resonance experiment, using the apparatus described by Bowers, Kamper, and Knight. (M.H.R.)

13470

THE APPLICATION OF VARIATIONAL METHODS TO ATOMIC SCATTERING PROBLEMS. V. THE ZERO ENERGY LIMIT OF THE CROSS-SECTION FOR ELASTIC SCATTERING OF ELECTRONS BY HYDROGEN ATOMS. M. J. Seaton (Univ. Coll., London). Proc. Roy. Soc. (London) A241, 522-30(1957) Sept. 10.

Calculations were made using the central-field, exchange and exchange-polarization approximations. In agreement with previous work it is found that the wave functions are profoundly modified by inclusion of exchange. The exchange radial equations are solved by numerical integration and by variational methods; consideration of the form of the equations for moderately large radial distances suggests an improved two parameter trial function which is found to give satisfactory results. Polarization, i.e., the inclusion of the interelectronic distance r_{12} in the trial function, is much more important for the symmetric than for the anti-symmetric case. A symmetric exchange-polarization trial function is obtained which appears more satisfactory than those previously employed. It may be hoped that the final result for the zero-energy elastic scattering cross-section, Q(0) 5.76×10^{-15} cm^2, is correct to within about 15%. (auth)

13471

ELECTROMAGNETIC PROPERTIES OF DEUTERON. II. Kiyomi Itabashi (Tohoku Univ., Sendai, Japan). Progr. Theoret. Phys. (Japan) 17, 80-8(1957) Jan.

The electric quadrupole moment of the deuteron is calculated by the formalism proposed in the first paper of this series and with the meson theoretical wave function of the deuteron. The result obtained agrees with the experimental evidence within the inevitable ambiguity involved in the present meson theory. The mesonic correction part of the quantity is found to be essentially due to the recoil effect, and therefore the calculated value is reliable only in a qualitative sense. However, the numerical calculation shows that this part amounts to only a few percent of the total value. This seems to be a further support to the discussions of Iwadare et al. on the applicability of the meson theory of the nuclear force in the low energy region. (auth)

13472

ON THE UNIVERSALITY OF THE WEAK INTERACTIONS. Suteo Gotô (Tokyo Gakugei Univ., Japan). Progr. Theoret. Phys. (Japan) 17, 107-23(1957) Jan.

The possibility of extending the concept of iso-spin to leptons produced in the lepton reactions — the K-meson decays ($K_{\mu 2}$, $K_{\mu 3}$, and K_{e3} decays), pion decays, muon decays, β-decays, and nuclear capture of muon — is investigated. If the iso-spin $\frac{1}{2}$ is assigned for muons and electrons, and zero for the neutrinos produced in the $K_{\mu 2}$ decays, a suitable selection rule can be found which allows all the well established lepton reactions and forbids all the unwanted ones. This method is applied to the K-meson decays in which the lepton reactions coexist with the boson-boson decays ($\tau \to 3\pi$, $\theta \to 2\pi$). (auth)

13473

ELASTIC SCATTERING OF 24.6-Mev ALPHA PARTICLES BY Au. Sin-iti Igarasi and Torahiko Takano (Tokyo Univ. of Education, Japan). Progr. Theoret. Phys. (Japan) 17, 124-6(1957) Jan.

In order to see how various partial waves contribute to the cross section, the differential elastic scattering cross section of 24.6-Mev alpha particles from Au is calculated by the exact partial wave method. The calculation has been carried out by using the continuum theory for the interaction between incident alpha particles and the target nucleus, because the compound nucleus formed by the capture of the alpha particle is supposed to have many open channels. (M.H.R.)

13474

NOTE ON THE ISOTOPIC SPIN OF THE ANTIPARTICLE. Shinzo Nakai (Osaka Univ., Japan). Progr. Theoret. Phys. (Japan) 17, 139-44(1957) Feb.

Charge conjugation is studied in a different form from the usual one, and the assignments of the eigenvalues of the isotopic spin operator τ_3 for antiprotons and antineutrons are discussed. As an illustrative application, the annihilation process of a nucleon and an antinucleon is dealt with. (auth)

13475

EFFECT OF HARD CORES ON THE BINDING ENERGIES OF H^3 AND He^3. II. Takashi Ohmura and Masami Yamada (Univ. of Tokyo) and Masato Morita (Kobayasi Inst. of Physical Research, Kokubunzi, Tokyo). Progr. Theoret. Phys. (Japan) 17, 326-30(1957) Mar.

Theoretically calculated binding energies of H^3 and He^3 were reported previously where two-body forces of exponential type with hard core cut-offs were assumed. Now, the results of similar calculations with two-body forces of the Yukawa type which are cut off by hard cores are shown. Only central forces are used and the force parameters are determined from the two-nucleon data at low energies as was done in the preceding paper. This change in the radial form of the nuclear force does not alter the qualitative features of the effects of hard cores: i.e., Hard cores reduce the binding energies of H^3 and He^3. Hard cores push out the wave functions of H^3 and He^3, so that the Coulomb energy of He^3, which is too large without the hard cores, is brought into agreement with the experimental value of the difference between the binding energies of H^3 and He^3. (auth)

13476

SPIN-ORBIT COUPLING IN HEAVY NUCLEI. Jun-ichi Fujita and Hironari Miyazawa (Univ. of Tokyo). Progr. Theoret. Phys. (Japan) 17, 366-72(1957) Mar.

The three-body forces in the static approximation were previously calculated. Using the result a strong spin-orbit coupling, compared with the Thomas term, is derived in this paper. Though it is not sufficient to explain the observed spin-orbit coupling for itself, it is expected that a considerable part of the nuclear spin-orbit interaction should be due to the many-body forces. (auth)

13477

THE MAGNETIC OCTUPOLE MOMENTS OF NUCLEI. Shôta Suekane and Yoshio Yamaguchi (Osaka City Univ.). Progr. Theoret. Phys. (Japan) 17, 443-8(1957) Mar.

The magnetic octupole moment Ω of the nucleus is discussed on the basis of the shell and collective models. In the strong coupling case of the collective model, Ω becomes smaller than the shell model result because of the quenching of the moment along the symmetry axis of the deformed core. This fact is in agreement with experimental data (for $Ga^{71, 73}$, In^{115}, and I^{127}) available at present. (auth)

13478

ANTIPROTON-NUCLEUS AND ANTIPROTON-PROTON INTERACTIONS. M. Nozawa, T. Goto, N. Yajima, and R. Nakasima (Osaka Univ.). Progr. Theoret. Phys. (Japan) 17, 504-6(1957) Mar.

Recent experiments carried out at Berkeley show that the attenuation cross sections of antiproton beams by Cu and Be are about twice those of protons. An attempt is made to explain these experimental results on the basis of a simple optical model. (M.H.R.)

13479

K-π INTERACTION AND K^+-N SCATTERING. Shigeo Minami (Osaka City Univ.). Progr. Theoret. Phys. (Japan) 17, 508-10(1957) Mar.

13480

A REMARK ON THE LEPTON PROCESSES. Suteo Gotô (Tokyo Gakugei Univ.). Progr. Theoret. Phys. (Japan) 17, 517-18(1957) Mar.

An appropriate isospin and strangeness are assigned for leptons and for each lepton having strangeness s, and the following relation is assumed between the third component I_3 and charge Q, $Q = I_3 + \frac{1}{2}u$, $u = n + s$, where n is the lepton number. (M.H.R.)

13481

THE *l*-FORBIDDEN MAGNETIC DIPOLE TRANSITIONS. Akito Arima and Mitsuo Sano (Univ. of Tokyo, Japan) and Hisashi Horie (Tokoyo Inst. of Tech., Japan). Progr. Theoret. Phys. (Japan) 17, 567-80(1957) Apr.

The reduced matrix elements for *l*-forbidden magnetic dipole transitions in medium-weight nuclei are calculated on the basis of configuration mixing. The calculations are based upon simple perturbation theory. The parameters used in this calculation are the same as those adopted for the magnetic and quadrupole moments in previous work. The lifetimes of these radiative processes are well explained by small admixtures of excited configurations to the shell model configurations. (auth)

13482

ELECTRON-NEUTRON INTERACTION. Fujio Ando and Hironari Miyazawa (Univ. of Tokyo, Japan). Progr. Theoret. Phys. (Japan) 17, 607-9(1957) Apr.

An interpretation is given for the electrostatic interaction due to the separation of the neutron into proton and pion. (M.H.R.)

13483

ON THE ANNIHILATION CROSS SECTION OF THE ANTI-NUCLEON AND THE NUCLEON. Yoshio Yamaguchi (Osaka City Univ., Japan). Progr. Theoret. Phys. (Japan) 17, 612-13(1957) Apr.

13484

THE ISOMERISM OF In^{114}. Klaus-Werner Hoffmann. Z. Physik 148, 298-302(1957). (In German)

By the use of an anthracene cleavage crystal spectrometer, the total conversion coefficient α of In^{114} (half life of 49 days) is measured and the K/L ratio estimated. The values $\alpha = 4.3 \pm 0.4$ and $K/L = 2.0 \pm 0.6$ are reported. For this isomer an E-4 transition is in agreement with earlier measurements. (tr-auth)

13485

MEASUREMENT OF THE CORRELATION BETWEEN β AND CIRCULARLY POLARIZED γ RAYS IN Co^{60}, Zr^{95}, AND Sb^{124}. H. Appel and H. Schopper. Z. Physik 149, 103-6(1957). (In German)

NUCLEAR REACTORS

13486 AERE-M/R-2250

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

SOME INVESTIGATIONS ON THE PREPARATION AND PROPERTIES OF METALLIC SLURRY SYSTEMS WITH PARTICULAR REFERENCE TO PARTICLE BEHAVIOUR. G. W. Greenwood and B. Sharpe. Dec. 2, 1954. Decl. Mar. 6, 1957. 29p.

Factors influencing the selection of metallic slurry systems for possible use as reactor fuel elements are considered. The systems UPb_3 in lead, U_3Bi_5 in Bi, and U in Na have been examined in some detail. An account is given of their preparation and properties, particularly in respect to particle growth. The growth mechanism has been analyzed theoretically and the calculated growth rates are of the same order as the experimental values. Work in progress and some lines of further development are briefly discussed. (auth)

13487 AERE-T/R-2211

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

THE BEHAVIOUR OF A FLUX OF NEUTRONS IN THE NEIGHBOURHOOD OF A CONTROL PLATE. R. J. Royston. Mar. 1957. 20p.

A partially absorbing flat plate, the material of which does not scatter neutrons, is surrounded by a medium containing uniformly distributed neutron sources. The behavior of the flux in the surrounding medium is considered by means of the spherical harmonics method, and the linear extrapolation length at the surface of the plate is determined as a function of the capture probability in the sur-

rounding medium. The rate of absorption of neutrons by the plate is then calculated in one case, and the error introduced by using the diffusion theory to calculate this quantity is determined. (auth)

13488 ANL-5782
Argonne National Lab., Lemont, Ill.
A MEASUREMENT OF THE TRANSFER FUNCTION OF A FAST CRITICAL ASSEMBLY. J. F. Boland, R. R. Smith, and R. E. Rice. Sept. 1957. 16p. Contract W-31-109-eng-38. $0.50(OTS).

The zero power transfer function of the ZPR-III mock-up assembly of EBR-I, Mark III was obtained over a frequency range from 0.01 to 10 cycles per second. Various oscillator rod materials and shapes were investigated in order to determine the type of oscillator rod that would give the desired amplitude and wave shape for use in future measurements in the EBR-I, Mark III. A null balance system was used to obtain the amplitude and phase data to a reasonably high degree of accuracy. (auth)

13489 CRT-715
Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.
EFFECTIVE THERMAL DIFFUSION LENGTH IN A SANDWICH REACTOR. B. Davison. July 1957. 89p. (AECL-461).

Several, not mutually equivalent, definitions are possible of the effective thermal diffusion length for a lattice reactor. It is here defined by equating the conventional expression for the thermal non-leakage probability, (in terms of buckling and the thermal diffusion length) to the value of this non-leakage probability as calculated on the basis of the exact transport theory. With this definition the effective thermal diffusion length is evaluated for the sandwich reactor and compared with the expressions for the effective thermal diffusion length currently in use. In the case of the transverse diffusion, some difficulty arises since the non-leakage probability depends not only upon the size of the system and the lattice characteristics, but also upon the position of the reactor boundaries relative to the cell. This difficulty is overcome by averaging over-all the possible positions of the reactor boundaries. (auth)

13490 CWR-464(Del.)
Curtiss-Wright Corp. Research Div., Quehanna, Penna.
A CONCEPTUAL DESIGN STUDY OF AN ADVANCED ENGINEERING TEST REACTOR. May 1, 1957. Decl. with deletions June 24, 1957. 70p. Contract AT(30-3)-275. $1.75(OTS).

A technical description is given of an Advanced Engineering Test Reactor (ATR) conceptual design containing seven major vertical test loops and approximately forty capsule irradiation locations. The peak flux is approximately 5×10^{15} n/cm^2–sec and the average unperturbed flux is 3.5×10^{15} n/cm^2–sec (both values at 186°F). The useable flux within a water filled test loop is approximately 2×10^{15} n/cm^2–sec at the center loop and 10^{15} n/cm^2–sec in any of the six surrounding loops. A maximum to minimum flux ratio of two is satisfied axially over the center three feet of the core. The design is based upon cylindrical geometry utilizing solid fuel elements in a heavy water moderated core. A graphite reflector surrounds the core region while a heavy water graphite combination serves as the top and bottom reflector. The overall dimensions are a seven foot diameter by five foot length core with an eighteen inch reflector. The reactor is designed for a five day fuel burnup cycle using boric acid as a poison dissolved in the heavy water moderator. The reactor is mounted within a large pressure vessel which is also cooled by moderator circulation. The heavy water moderator acts as a primary coolant and is circulated directly to an external heat exchanger. Light water is to be used as a secondary coolant. Total power at start-up is 520 Mw and 360 Mw at shutdown. The peak power per tube is 6.2 Mw and 4.6 Mw, respectively at start-up and shutdown. The initial critical loading is 33 pounds of fully enriched uranium. A fuel element of circular cross section, consisting of 11 concentric fuel bearing shells and a 2.7 inch o.d. non-fuel bearing outer shell is proposed. An insulating sleeve composed of a one inch thick ring of Al_2O_3 surrounded by a $\frac{1}{4}$ inch thick ring of diatomaceous earth is proposed for location next to the inner wall of the test hole and the associated wall temperatures and stresses are presented. A preliminary design of external heat exchanger is tabulated in detail. A brief study of possible sites indicated that the criteria of cold water, electric power, insolation, transportation and waste disposal facilities are the controlling factors in that order of importance. Existing Atomic Energy Commission sites were considered and Hanford, Washington was chosen as the most desirable. (auth)

13491 HARE-13
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
COMPONENT ACTIVITIES IN THE FUEL CIRCUIT OF A HOMOGENEOUS AQUEOUS REACTOR. S. R. Armsdon and C. L. Brown. May 11, 1955. Decl. July 22, 1957. 5p.

13492 IDO-16390
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
A FOUR-REGION, TWO-GROUP CALCULATION OF SPERT III CRITICAL SIZE AND FLUX DISTRIBUTION. D. R. Metcalf and V. C. Kobold. July 18, 1957. 6p. Contract AT(10-1)-205. $0.50(OTS).

Critical size and flux distributions were calculated, using the four-region two-group model based on the present design of the SPERT III reactor. These calculations were made for the 650°F case. The critical size was determined to be about 27.3 cm. This was an increase of about 8% in critical mass in going from an infinite water reflector to a reflector and thermal shields with significant amounts of stainless steel. (auth)

13493 IGR-TN/R-641
United Kingdom Atomic Energy Authority. Industrial Group, H. Q., Risley, Lancs, England.
CONTROL ROD REQUIREMENTS IN A THERMAL REACTOR. A. Hitchcock. Aug. 1957. 7p.

It has been the practice to calculate an 'amount of control' and balance this against an 'amount of control required.' The latter amount is the sum of a number of values such as temperature effects, reactivity changes etc. The procedure is imprecise because the terms are variously interpreted thus giving considerable latitude in the calculations. Recommendations showing the calculations needed to match performance of the control rods with the reactor are made. (auth)

13494 IGR-TN/R-642
United Kingdom Atomic Energy Authority. Industrial Group, H. Q., Risley, Lancs, England.
THE CALCULATION OF THE EFFECTIVENESS OF CONTROL RODS IN A THERMAL REACTOR. B. Cutts. Aug. 1957. 11p. (NPCC/RPWP/P-68).

The "super-cell" method of control rod calculations which may be used in reactors containing large numbers of rods is described as an alternative to the more conventional methods. (auth)

13495 IDO-16384

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

COMPARISON OF FLUX AND POWER DISTRIBUTIONS, AND VOID AND TEMPERATURE COEFFICIENTS OF THE MTR WITH U^{235}, AND Pu^{239} FUEL. B. W. Johnson and H. L. McMurry. July 26, 1957. 29p. Contract AT(10-1)-205. $1.00(OTS).

Calculated flux and power distributions and void and temperature coefficients are compared for the MTR fueled with U^{235} and Pu^{239}. The calculations take account of epithermal capture and fissioning in the Pu^{239} system. The Pu^{239} system gives a 20% higher fast to thermal flux ratio in the core and exhibits a thermal flux build-up in the reflector almost twice the magnitude in the U^{235} system. The power density at the core-reflector interface is 9% higher in the Pu^{239} system. The void and temperature coefficients, calculated for uniform changes in the cores only, are negative and about the same. The void coefficient is -0.16% $\delta k/k$ per percent void, and the temperature coefficient is -0.005% $\delta k/k$ per degree F. (auth)

13496 IDO-16398

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

REACTIVITY EFFECTS OF Xe^{135} AND Sm^{149} FOR THE MTR WITH U^{235} AND Pu^{239} FUELS. B. W. Johnson and H. L. McMurry. Aug. 8, 1957. 8p. Contract AT(10-1)-205. $0.50(OTS).

The reactivity absorbed by equilibrium Xe^{135} and Sm^{149} poisons in the MTR fueled with U^{235} and Pu^{239} is computed to be 3.9 and 3.4%, respectively. This difference is too small to be significant as far as fuel requirements are concerned. The equilibrium poison concentration is higher in the Pu^{239} fueled reactor, but this is offset by the production of neutrons in the epithermal region where competition from Xe^{135} and Sm^{149} is not important. (auth)

13497 KAPL-1703

Knolls Atomic Power Lab., Schenectady, N. Y.

PILE OSCILLATOR TECHNIQUES AND THE ERROR ANALYSIS OF OSCILLATOR MEASUREMENTS. F. Feiner, R. T. Frost, and H. Hurwitz, Jr. Oct. 26, 1956. 38p. Contract W-31-109-Eng-52. $1.00(OTS).

Experimental equipment, measuring techniques, and methods of analysis developed at KAPL for use in pile oscillator experiments are described. A detailed derivation of expressions for the signal-to-noise ratio is included and discussed. (D.E.B.)

13498 KAPL-1787

Knolls Atomic Power Lab., Schenectady, N. Y.

ENVIRONMENTAL HAZARD EVALUATIONS FOR CRITICAL ASSEMBLIES. J. J. Fitzgerald and R. J. Feinberg. Dec. 5, 1956. 33p. Contract W-31-109-Eng-52. $1.00 (OTS).

Although critical assemblies are not at this time inherently safe, the probability of an incident is very small, and the hazards can be restricted to a relatively small area. The radiation exposures of personnel can be reduced by adequate emergency planning and a reasonable evacuation procedure. Criteria for evaluating critical assembly hazards and for site selection are presented in this report. (auth)

13499 KAPL-M-RES-40

Knolls Atomic Power Lab., Schenectady, N. Y.

LEAKAGE FLOWS. (Contains Data for Estimating Core By-Pass Leakages and Flow Losses from Penetrations in the Pressure Containing System.) H. F. Larkin. [Aug. 1957]. 19p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

Leakage flow which bypasses the important heat generation regions in the core of a nuclear reactor can be of considerable importance since it reduces thermal margin and may limit reactor operation. Leakage flow out of penetrations in the pressure containing system of a nuclear reactor is important since the core may burn out if excessive fluid is lost from a penetration due to an accident or other cause. Data are presented which will enable quick order-of-magnitude estimates of leakage which are usually satisfactory for design work. Only single phase flow is considered. This will give conservative results for penetrations in the pressure container. A method of bracketing the flow loss from most container penetrations is presented. (auth)

13500 KAPL-M-RES-47

Knolls Atomic Power Lab., Schenectady, N. Y.

MEASUREMENT TECHNIQUES FOR PLENUM MIXING, TIME CONSTANTS, AND FLOW DISTRIBUTION. H. F. Larkin. July 26, 1957. 9p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

In many cases the plenum geometry is such that it is not possible to determine all mixing and time constants by analysis. Therefore, much of the data for plenum constants must be based on the interpretation of test data. Some of the test techniques in use, and their advantages and pitfalls, are discussed. (D.E.B.)

13501 KAPL-M-SMS-74

Knolls Atomic Power Lab., Schenectady, N. Y.

POWER PLANT COOLANT TECHNOLOGY PROGRAM. S. L. Williams. July 5, 1957. 17p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

Brief summaries of studies of high temperature water purification; corrosion product distribution and activity buildup; coolant sampling techniques; high pH effects; coolant deaeration, chemical treatment, and radiation catalyzed reactions; and fission product contamination and removal are given. (D.E.B.)

13502 KAPL-M-WCJ-2

Knolls Atomic Power Lab., Schenectady, N. Y.

RADIOCHEMICAL STUDIES OF FISSION PRODUCTS AND ACTIVATED CORROSION PRODUCTS IN THE COOLANT OF TEST LOOPS FOR SAR FUEL ELEMENTS AT THE MATERIALS TESTING REACTOR. W. C. Judd and F. J. Witt. Aug. 20, 1957. 14p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

13503 NAA-SR-2027

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

SODIUM GRAPHITE REACTOR QUARTERLY PROGRESS REPORT [FOR] APRIL–JUNE 1957. R. W. Dickinson, ed. Sept. 1, 1957. 53p. Contract AT(04-3)-49. $0.40(OTS).

Significant items of progress in the Sodium Graphite Reactors program for this period are outlined. The SRE wet critical mass was determined to be 32.64 ± 0.10 fuel elements at 400°F by achieving criticality. The worth of the safety rods was determined by drop experiments. Reactivity change measurements were made on Th–U fuel elements. Studies were made of a steady-state and variable load SGR heat transfer system. This study included steam plant costs at different reactor temperatures, 850 and 950°F steam. Results are presented. Detailed theoretical calculations on the long term reactivity changes expected in the SRE were initiated. At this time only approximate calculations of the reactivity changes have been made. Decontamination of the primary hot cell has progressed satisfactorily. Levels are now low enough to permit entry by personnel in protective clothing. The remaining fuel specimens have been examined in the SRE hot cell. Diameter

changes, estimated total atom burnup and irradiation temperatures are listed. In canning experimental fuels it was found that the amount of NaK added is critical. Experiments have shown that the amount of NaK to be added is between 6.00 and 6.35 cubic inches. The casting of U into Zr thin walled tubes appears promising. Further work with Zr will be investigated. The conceptual design of the moderator can removal cask is approximately 75% completed. Construction of the 6-inch sodium pump and test loop is complete. The modifications of the 2-inch pump test loop are also complete. Tests of the prototype Mark I control rod revealed that this design is not suitable for use as an SRE regulating rod. The area of difficulty in the Mark I design is the inability of the ball-nut lead screw to operate for more than 10,000 regulating cycles. During tests on the Mark I safety rod prototype the thimble developed severe leaks. The thimble was modified and proved satisfactory. Tests were terminated due to latch failures. Failure of the freeze seal on the main primary sodium pump resulted in flooding of the pump case. The pump was removed, repaired and reinstalled with an improved gas seal gasket arrangement. (For preceding period see NAA-SR-1941.) (auth)

13504 ORNL-2329

Oak Ridge National Lab., Tenn.

EXPERIMENTS ON THE KINETICS OF THE HRE. Date of Experiments: October 1953. V. K. Pare' and Sidney Visner. Oct. 8, 1957. 38p. Contract W-7405-eng-26. $1.25(OTS).

Reactivity was added at rates up to 0.7% per second at initial power levels from one watt to 20 kw and the transient power behavior was observed. Reactivity was increased by various means: control rods, reflector level, fuel concentration, and fuel temperature. The experiments were performed to check theoretical safety calculations which predicted that the reactor would be self-stabilizing and capable of absorbing large introductions of reactivity. The power level rose to a peak for each reactivity excursion, in some cases several times higher than the rated power of one Mw, but decreased rapidly to an equilibrium value determined by the rate of increase of reactivity. For the most violent experiment, in which cold fuel from the heat exchanger was injected into the core, a peak power of 11 Mw was observed with a shortest period of 35 msec. The peak powers are in reasonable agreement with calculations in which a solution of the kinetic equations with the temperature coefficient of reactivity neglected (valid at low power) is joined to a solution in which the delayed neutrons are neglected (valid when prompt critical is exceeded). The kinetic equations in the latter case have been integrated numerically to facilitate the analysis. (auth)

13505 UCRL-4919

California. Univ., Livermore. Radiation Lab.

THE LIVERMORE POOL TYPE REACTOR (LPTR). John B. Radcliffe, Jr. July 1957. 61p. Contract W-7405-eng-48. $1.75(OTS).

The LPTR is a tank-type thermal heterogeneous research reactor facility at the Livermore site. The H_2O moderated and cooled reactor core will generate a peak flux in excess of 10^{13} n/cm^2-sec at its initial operating power of 1 Mw. Access to the flux is provided by a variety of experimental facilities, including 6 horizontal beam tubes (the largest almost 13 in. in diameter), 2 thermal columns (one largely removable to provide a high fast flux within an associated cave-like irradiation cell), and 3 pneumatic tubes (one provides access to a thermal flux trap in the center of the core). These, combined with a number of other irradiation ports are intended to make the reactor a versatile, flexible research tool, available to all groups within the UCRL research program. The LPTR design calls for a core containing roughly 4 kg of U^{235} in fuel elements of the MTR type, arranged within a 5 by 7 element grid configuration which also provides space for a reflector (both graphite and beryllium are available). Aluminum is the primary structural material in the core, and in the closed circuit cooling system. A compact biological shield is achieved through use of magnetite concrete. The reactor core is controlled by 4 B_4C shim safety rods and a stainless steel regulating rod, with conventional console control instrumentation. Total containment is emphasized in the reactor housing—an all-steel, air-tight structure which is connected to adjacent labs and the control room by an airlock. (auth)

13506 UK/C/5/103

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

MULTIPLE METAL ROD ASSEMBLIES IN ZEEP. E. Critoph. PART A. A. Okazaki and D. W. Hone. PART B. P. R. Tunnicliffe, G. R. DeMille, and G. C. Hanna. [Paper presented at] Fifth UK/Canada Technical Conference, October 22-24, 1956. 18p.

Lattice experiments are being done in ZEEP with 19-element, U metal rods. The geometrical details of these rods are shown. Hexagonal lattices composed of these rods were assembled in ZEEP. These were lattices with hexagonal spacings of 8.66, 10.00, and 11.50 in. (W.L.H.)

13507 WAPD-166

Westinghouse Electric Corp. Bettis Plant, Pittsburgh.

REACTOR CRITICALITY AND NON-NEGATIVE MATRICES. Garrett Birkhoff and Richard S. Varga. Aug. 1957. 50p. Contract AT-11-1-GEN-14. $1.50(OTS).

Mathematically rigorous foundations are given for certain aspects of the theory of reactor criticality. Thus, various discrete approximations to time-dependent neutron diffusion equations can be written $d\underline{\varphi}/dt = Q\underline{\varphi}$, where Q is a suitable transitive, essentially non-negative matrix. In such cases, the critical distribution may be defined as the positive eigenvector of Q. The existence, uniqueness, and stability of this eigenvector were proved by Perron and Frobenius. The importance vector can be defined dually; it has similar properties. The supercritical, critical, and subcritical cases are those for which the associated (real) eigenvalue of Q is positive, zero, or negative. Alternatively, they are the cases in which, for some positive φ, $Q\underline{\varphi} > 0$, $Q\underline{\varphi} = 0$, or $Q\underline{\varphi} < 0$, respectively. Schemes for calculating critical distributions on digital computing machines commonly involve semi-transitive non-negative matrices $A_k^{-1}B_k$, through systems of matrix equations $A_k\underline{\varphi}_k = B_k\underline{\varphi}_{k-1}$. The convergence of "outer" iterations is shown to follow from extensions of the Perron-Frobenius theory. Young's Lemma on paired eigenvalues, which plays a key role in Successive Overrelaxation, is shown to follow from the related Frobenius theory of "cyclic" matrices. Other results proved include: a minimax property for coupled critical distribution and importance vectors; the monotone dependence on ν of the largest eigenvalue of $A + \nu B$; the existence of complex eigenvectors. Finally, rigorous definitions are given for the transition matrix and multiplication factor, and it is shown $-A^{-1}$ is positive, for A transitive and essentially non-negative, if and only if $d\underline{\varphi}/dt = A\underline{\varphi}$ is subcritical. (auth)

13508 WAPD-C-171

Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.

CHEMICAL ASPECTS OF REACTOR CONTROL. Z. M.

Shapiro, R. H. Giffen, W. T. Lindsay, Jr., R. F. Newton, and M. H. Feldman. Oct. 27, 1953. Decl. Apr. 3, 1957. 58p. Contract AT-11-1-GEN-14. $10.80(ph OTS); $3.90 (mf OTS).

An outline is presented of the problems, difficulties, and direction in which an experimental program for the control of nuclear reactors by chemical means should proceed. The possible applications of chemical control are discussed with regard to both land-based and mobile power plants. (W.L.H.)

13509 WAPD-PWR-CP-2245

[Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.]

FISSION PRODUCT ACTIVITY LEVELS IN PWR PRIMARY COOLANT AND REACTOR PLANT CONTAINER AIR. A. S. Kesten and W. T. Lindsay. [July 11, 1956]. 9p. $1.80(ph OTS); $1.80(mf OTS).

The results show that if the product of the number of defected, average-power rods in PWR and the leak rate, in units of liters/hr, is equal to 91, the air activity in the plant container and at the point of discharge from the stack would be one tenth of the maximum permissible concentration based on Table III of U. S. National Bureau of Standards Handbook 52. No credit was taken for decontamination or decay during leakage, fall-out in the container, or removal of radioisotopes by filtration of air. The calculations presented assumed that the rate of escape of the radioisotopes is proportional to the concentration of the radioisotope in the fuel. This assumption is a more satisfactory description of the mode of release for the fission products than that the escape rate was proportional to the fissioning rate. Values of the escape rate coefficient (ν), the constant of proportionality between escape rate and isotope concentration in fuel, are given. (auth)

13510 WAPD-TM-67

Westinghouse Electric Corp. Bettis Plant, Pittsburgh. CROSS SECTIONS IN THE SOFOCATE CODE: SECOND DECK. Harvey Amster. June 1957. 32p. Contract AT-11-1-GEN-14. $6.30(ph OTS); $3.00(mf OTS).

Except for the final averaging of microscopic cross sections, the calculations in the SOFOCATE code depend on the stored functions $C_i(E)$. The various $C_i(E)$'s are defined, their ordinary and special uses are described, and their values are given. (D.E.B.)

13511

PRELIMINARY DESIGN OF AN LMFR POWER PLANT. D. Mars, J. N. Inglima, and R. T. Schomer (Babcock & Wilcox Co., New York). Nuclear Sci. and Eng. 2, 582-601 (1957) Sept.

A study group comprising personnel from seventeen industrial organizations and working at Brookhaven National Laboratory has evaluated the Liquid Metal Fuel Reactor (LMFR) concept, and has prepared a preliminary design of a large central station power plant feasible for construction. The important characteristics of that design are presented together with discussions of the economics and of the remaining research and development work required. The plant utilizes a 550 Mw reactor with a circulating fuel solution of U^{233} dissolved in Bi and a breeder fluid of ThBi dispersed in Bi. Two-thousand (2000) psig, 975°F steam is delivered to a turbo-generator plant, producing 226,000 kw of net electrical power. Power costs, based on both single plants and multiple units utilizing common chemical processing facilities, range from 6.5 to 8.5 mils/kw-hr. (auth)

13512

NONDESTRUCTIVE TESTING OF REACTOR FUEL ELEMENTS. W. J. McGonnagle (Argonne National Lab., Lemont, Ill.). Nuclear Sci. and Eng. 2, 602-16(1957) Sept.

Fuel element failures in a heterogeneous reactor may result in contamination by the fission products through various parts of the reactor and the associated coolant system. The consequences of such a failure are serious because of the costly and time consuming delays for reactor cleanup. The application of nondestructive tests helps to reduce fuel element failures by insuring the integrity of the fuel elements. Some of the nondestructive test methods and techniques that have been or can be used to test nuclear reactor fuel elements are reviewed briefly. (auth)

13513

DETERMINATION OF THE RATIO OF CAPTURE TO FISSION CROSS SECTIONS IN EBR-1. P. Kafalas, M. Levenson, and C. M. Stevens (Argonne National Lab., Lemont, Ill.). Nuclear Sci. and Eng. 2, 657-63(1957) Sept.

The variation of alpha, the ratio σ_c/σ_f, has been determined for U^{235} and Pu^{239} as a function of position in EBR. Samples of U^{235} and Pu^{239} were exposed in the core, inner blanket, and outer blanket; the samples were analyzed radiochemically to determine the fraction fissioned and mass spectrometrically to determine the fraction which had undergone the capture process. The vertical and horizontal patterns of capture and fission probability have been determined. The variation of η in the reactor has been plotted, assuming that $\overline{\nu}$ remains constant. (auth)

13514

RESONANCE ESCAPE PROBABILITY MEASUREMENTS IN Th-2% U-235 LIGHT-WATER MODERATED LATTICES. J. P. Phelps and R. Sher (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng. 2, 676-8(1957) Sept.

Values of the resonance escape probability in 0.387-in. diameter, 2% U^{235}–98% Th^{232} light-water moderated lattices have been measured. The results are p = 0.821, 0.859, 0.889, 0.918, 0.937 for water/metal volume ratios 1, 1.5, 2, 3, 4. These values are somewhat higher than corresponding ones measured in similar slightly enriched U lattices. (auth)

13515

A GENERAL TREATMENT OF FLUX TRANSIENTS. H. D. Brown (E. I. du Pont de Nemours & Co., Aiken, S. C.). Nuclear Sci. and Eng. 2, 687-93(1957) Sept.

The solution of the equations describing the reactor state is obtained by numerical integration of the differential equations on an IBM-650. The general description includes the dependence of lattice constants and absorption cross sections upon the temperatures of various components and accommodates the effects of manipulations of the geometric buckling and of the total absorption cross section. The reactor kinetic equations are put into difference form suitable for numerical solution. Measures are described for eliminating divergences introduced by the numerical treatment of the coupling among temperature coefficients, delayed neutrons, and flux. (auth)

13516

PROBLEMS IN NUCLEAR ENGINEERING. SELECTED PAPERS FROM THE 1ST NUCLEAR ENGINEERING AND SCIENCE CONGRESS HELD AT CLEVELAND, OHIO. VOL. I. D J. Hughes, Stuart McLain, and Clark Williams, eds. New York, Pergamon Press, 1957. 372p.

Papers are presented on safety, fuel production, and heat transfer problems concerned with the design of economical power plants. (M.H.R.)

13517

REACTOR OPERATIONAL PROBLEMS. SELECTED PAPERS FROM THE FIRST NUCLEAR ENGINEERING AND SCIENCE CONGRESS HELD AT CLEVELAND, OHIO. VOL. II. D J. Hughes, Stuart McLain, and Clark Williams, eds. New York, Pergamon Press, 1957. 285p.

Papers are included on the recovery of irradiated fuel, handling of plant effluents, experimental low-power assemblies, reactor physics, and control and instrumentation. (M.H.R.)

NUCLEAR TRANSFORMATION

13518

CROSS SECTIONS FOR PICKUP REACTIONS OF 14-Mev NEUTRONS WITH N^{14}. R. R. Carlson (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 107, 1094-8(1957) Aug. 15.

The absolute differential cross sections for the reactions $N^{14}(n,d)C^{13}$ and $N^{14}(n,d)C^{13*}$(3.68 Mev) were measured with 14-Mev neutrons at seven laboratory angles from 0 to 65°. The deuterons were detected with a coincidence-telescope spectrometer consisting of two proportional counters and a thin CsI(Tl) scintillator. The angular distributions are both fitted with Butler-type curves for angular momentum transfers of one in agreement with positive parity and spin one for the ground state of N^{14}. The reduced width for the ground state transition agrees with that for the reaction $N^{14}(p,d)N^{13}$ as required by charge symmetry of nuclear forces. The ratio of the reduced width for the ground state transition to that for the excited state transition rules out the possibility that the N^{14} ground state be a pure $^3D_1$ state. No yield was observed corresponding to the 3.09-Mev and 3.89-Mev states of C^{13}. (auth)

13519

INTERACTION OF NEUTRONS WITH OXYGEN AND A STUDY OF THE $C^{13}(\alpha,n)O^{16}$ REACTION. R. B. Walton, J. D. Clement, and F. Boreli (Univ. of Wisconsin, Madison). Phys. Rev. 107, 1065-75(1957) Aug.

Measurements of the oxygen total neutron cross section from 3.5 to 4.4 Mev and the $O^{16}(n,\alpha)C^{13}$ reaction cross section from 4.0 to 5.2 Mev are presented. In a study of the $C^{13}(\alpha,n)O^{16}$ reaction the following quantities were measured: the 0° yield from 0.8 to 3.5 Mev, 29° and 146° yields between 2.0 and 3.5 Mev, and 47 angular distributions in the range from 1.0 to 3.5 Mev. Cross sections for the $O^{16}(n,\alpha)C^{13}$ and the $C^{13}(\alpha,n)O^{16}$ reactions are compared using the principle of detailed balancing. On the basis of the $C^{13}(\alpha,n)$ angular distributions spin assignments for 14 states of O^{17} between excitation energies 7 and 9 Mev are discussed, and in some cases relative parity assignments are made. Reduced widths of the states of O^{17} were derived from the results of the experiments on the $C^{13}(\alpha,n)$ reaction and the oxygen total neutron cross section. (auth)

13520

BETA DECAY AND THE CONSERVATION OF PARITY. L. C. Biedenharn and H. E. Rorschach (Rice Inst., Houston, Texas). Phys. Rev. 107, 1075-6(1957) Aug. 15.

An interpretation of recent experiments on the conservation of parity is proposed, which, utilizing a zero-rest-mass neutrino and Yukawa's model for the beta decay, conserves C and P separately for the nucleons as well as conserving CP for the over-all beta interaction. (auth)

13521

CROSS SECTION FOR THE $Ca^{40}(\gamma,3p3n)Cl^{34}$ REACTION. Fritz D. Schupp, Clifford B. Colvin, and Don S. Martin, Jr. (Iowa State Coll., Ames). Phys. Rev. 107, 1058-61(1957) Aug. 15.

The cross section of $Ca^{40}(\gamma,3p3n)Cl^{34}$ as a function of photon energy was determined up to 70 Mev. With a threshold for the process below 35 Mev the cross-section function was found to have a resonance-shaped peak of 0.3 mb at 50 Mev with a width at half height of 6 Mev. The integrated cross section was 2.7 Mev-mb. The mode of the process is discussed on the basis of a statistical model. (auth)

13522

PARITY IN NUCLEAR REACTIONS. Neil Tanner (California Inst. of Tech., Pasadena). Phys. Rev. 107, 1203-4 (1957) Aug. 15.

The question of how accurately parity is conserved in nuclear reactions is studied in connection with (p,α) reactions in F^{19}. (M.H.R.)

13523

AN OBSERVATION ON THE ABUNDANCE OF μ MESONIC CATALYSIS OF NUCLEAR PROCESSES IN LIQUID HYDROGEN. H. Marschall and Th. Schmidt. Z. Physik 148, 233-5(1957). (In German)

In the blast chamber the indicated catalysis of the reaction $p + d \rightarrow He^3 + 5.4$ Mev indicates a strong preference for the formation of (pd) meson molecules as compared to the formation of (pp) meson molecules. An explanation of this result is given. (tr-auth)

PARTICLE ACCELERATORS

13524 AERE-GP/R-2205

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

NON-LINEAR EFFECTS IN SPIRAL RIDGE CYCLOTRONS. PART II. N. M. King. Apr. 1957. 41p.

Phase plots of median plane orbits are presented and discussed, with particular reference to the proposed conversion of the 110" Harwell synchrocyclotron. Non-linear resonances at the $2\pi/3$ and $2\pi/4$ modes in a four-ridged machine, and at the $2\pi/4$ and $2\pi/5$ modes in a six-ridged machine, are shown to lead to restriction on permissible amplitudes of radial oscillation. More complicated effects take place in the regions between resonance modes. It is concluded that successful conversion of the Harwell machine with N = 4 may depend on inhibiting the initiation of large oscillations near the center, where the $2\pi/4$-mode cubic resonance could lead to severe beam loss. Difficulties in theoretical interpretation of the dynamics in the central region are outlined, and it is suggested that this problem may be solved more satisfactorily by an experimental approach. A study of different types of mean field law indicates that the best way to incorporate frequency modulation in the conversion may be to preserve strict C.W. operation up to about 140 Mev, and then switch to a mean power law variation. (auth)

13525 AERE-TP/R-2174

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

EFFECT OF STRAIGHT SECTIONS ON PARTICLE DYNAMICS IN THE PROPOSED 6.5 GeV SPIRAL-RIDGED SYNCHROTRON. R. Taylor and W.Walkinshaw. Feb. 14, 1957. 14p.

Computations were done on the betatron oscillations in the proposed 6.5 Bev spiral ridged synchrotron with straight sections. It was found that the frequencies of oscillation vary with amplitude, and in particular pass through the values $\frac{1}{2}$ and 1 corresponding to instabilities, and that the motion becomes unstable for initial vertical displacements quite small relative to the available aperture. It is concluded that the present design is unsatisfactory. (auth)

13526 AERE-TP/R-2175

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

THEORY OF SPIRAL-RIDGED SYNCHROTRONS WITH

STRAIGHT SECTIONS. M. J. Mitchell and D. Morgan. May 1957. 28p.

The effect on the betatron oscillations of introducing straight sections into a spiral-ridged synchrotron is considered. Formulas are developed which are shown to be in good agreement with the results of direct computations. In particular, it is shown how, for the proposed synchrotron, the combination of weak radial focusing and fairly strong vertical focusing leads to the phenomenon of multiple closed orbits and also to wide variations of frequency of oscillation about these closed orbits. (auth)

13527 CERN-57-30

European Organization for Nuclear Research, Geneva.
PROJET D'UNE SOURCE D'IONS POLARISÉS. (Project for a Source of Polarized Ions). R. Keller. Aug. 1, 1957. 49p.

The magnetic separation method was chosen as the most advantageous for producing a source of polarized ions for a particle accelerator. Such a system is analyzed mathematically. (T.R.H.)

13528 MURA-361

Midwestern Universities Research Assn., Madison, Wis.
FREQUENCY MEASUREMENTS AND RESONANCE SURVEY IN THE ELECTRON MODEL SPIRAL SECTOR FFAG ACCELERATOR. R. Stump and B. Waldman. Aug. 30, 1957. 8p. Contract AT(11-1)-384. $3.30(ph OTS); $2.40 (mf OTS).

Beam intensities, vertical and radial betatron oscillation frequencies, and stop bands in the tuning range of the spiral sector FFAG accelerator were measured. The machine is tunable from $\nu_z = 0.46$ to 1.76 and $\nu_x = 1.12$ to 1.71. In this tuning region the resonances $\nu_z = 1$, $\nu_z = 0.5$, $\nu_z = 1.5$, $\nu_x = 1.5$, $\nu_x + \nu_z = 2$ and $2\nu_x + 2\nu_z = 6$ are observed to destroy the beam. Of these only $\nu_z = 1$, $\nu_z = 0.5$ and $2\nu_x + 2\nu_z = 6$ cause complete loss of beam at all points in the available tuning range. The Walkinshaw resonance ($2\nu_z - \nu_x = 0$) appears as a minimum of beam intensity. (auth)

13529 UCRL-3777

California. Univ., Berkeley. Radiation Lab.
THE ELECTRICAL DESIGN OF A HEAVY-ION ACCELERATOR. Ferdinand Voelker. Aug. 20, 1957. 13p. Contract [W-7405-eng-48]. $3.30(ph OTS); $2.40(mf OTS).

A linear accelerator designed to accelerate particles of at. wt. 12 to 20 (through neon) is now in operation in Berkeley. Descriptions are given of the injector, the short section of linear accelerator, the stripper, and the main section of the accelerator. The injector consists of an ion source, the electronic equipment to pulse-power it, and a 500 kw Cockcroft-Walton power supply using dry-disc rectifiers. (auth)

13530 UCRL-3947

California. Univ., Berkeley. Radiation Lab.
BEVETRON POWER SUPPLY OPERATING AND MAINTENANCE PROBLEMS. J. G. Harding. Aug. 12, 1957. 4p. Contract [W-7405-eng-48]. $1.80(ph OTS); $1.80(mf OTS).

13531

A NEW PARTICLE ACCELERATOR. Yatendra Pal Varshni (Allahabad Univ., India). Indian J. Phys. 31, 384-6(1957) July.

A new method that overcomes the relativistic limitation to acceleration in cyclotrons by changing the shape of the dees is suggested. The proposed shape is one with a slanting curved gap. The ultimate shape is that of a spiral. (M.H.R.)

RADIATION ABSORPTION AND SCATTERING

13532 NARF-57-42T

Convair, Fort Worth, Tex.
SPECTRAL AND ANGULAR DISTRIBUTIONS OF AIR SCATTERED Co^{60} GAMMA RAYS. B. S. Burton, Jr. Sept. 18, 1957. 32p. Project 6(1-9964). Contract AF33(600)-32054. (MR-N-168).

Angular and spectral distributions of air-scattered gamma radiation from an isotropic Co^{60} source have been measured with a total-absorption gamma-ray spectrometer. The observed spectra exhibit structure which may be associated with singly and multiply scattered gamma rays. The upper energy cut-offs of the spectra agree well with those calculated from the theory of Compton scattering. The measured intensities at 40- and 89-foot source-detector distances are consistent with an inverse-distance law, i.e., the intensity is proportional to $r^{-0.87}$ where r denotes the distance from the source. (auth)

13533

DISPERSION RELATIONS FOR NUCLEON-NUCLEON SCATTERING. M. L. Goldberger (Princeton Univ., N. J.), Y. Nambu (Univ. of Chicago, Ill.), and R. Oehme (Inst. for Advanced Study, Princeton, N. J.). Annals of Physics 2, 226-82(1957) Sept.

Dispersion relations for nucleon-nucleon scattering are presented. The general case of nonforward scattering is treated, although the majority of the discussion is confined to the limiting cases of forward scattering and the nonrelativistic approximation. It is shown that in the relativistic approximation. It is shown that in the relativistic case the dispersion relations for nucleon-nucleon scattering necessarily involve the nucleon-antinucleon amplitude. Some qualitative conclusions are drawn about the differences between the nucleon-nucleon and nucleon-antinucleon interactions. The concept of a potential in quantum field theory is discussed briefly. (auth)

13534

AN APPROXIMATE EXPRESSION FOR GAMMA-RAY DEGRADATION SPECTRA. U. Fano and Ann T. Nelms. J. Research Natl. Bur. Standards 59, 207-10(1957) Sept.

The equation for gamma-ray degradation spectra is reduced to a form suitable for a simple approximation. The approximation is valid in a wavelength range between two Compton wavelengths larger than the wavelength of the source and the region where photoelectric absorption becomes very intense; this range is wide for low Z materials. Input data are provided for application to various materials and source energies. The results of sample calculations are shown and compared with those obtained by standard numerical calculation. (auth)

13535

MULTIPLE SCATTERING OF NEUTRONS. G. W. Stuart (General Electric Co., Richland, Wash.). Nuclear Sci. and and Eng. 2, 617-25(1957) Sept.

A variational principle is derived for the probability that a neutron incident upon a body of arbitrary shape and suffering multiple collisions within the body, will be absorbed by the body. Using constant trial function, the variational results are compared to sensibly exact numerical results for the case of an infinite cylinder. (auth)

13536

SYMMETRIES IN THE ELASTIC SPIN ½-SPIN 0 SCATTERING. R. Van Wageningen and H. J. Groenewold. Physica 23, 720-6(1957) Aug.

For the elastic scattering of spin ½ particles by spin 0 scatterers four sets of closely related phase shifts are considered, namely: $\{\eta_l^{\pm(0)}\}$; $\{\eta_l^{\pm(1)} = -\eta_l^{\pm(0)}\}$; $\{\eta_l^{+(2)} = \eta_{l+1}^{-(0)}$,

$\eta_{l+1}^{-(2)} = \eta_l^{+(0)}\}$; $\{\eta_l^{+(3)} = -\eta_{l+1}^{-(0)}$, $\eta_{l+1}^{-(3)} = -\eta_l^{+(0)}\}$. Experimentally these four sets can only be distinguished from each other by polarization measurements before and after the scattering. A short discussion on the interactions responsible for the phase shifts is added. (auth)

13537

GENERALIZED EFFECTIVE RANGE THEORY FOR NUCLEON-NUCLEON SCATTERING. Robert B. Raphael (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev. 107, 1135-44(1957) Aug. 15.

A method is proposed for obtaining limitations on the shape and possible energy dependence of the force in a given scattering state of the two-nucleon system, from a knowledge of the phase shift in that state over the non-relativistic domain, and is illustrated for ^1S waves. (auth)

13538

ELASTIC SCATTERING OF LOW ENERGY NUCLEONS BY COMPLEX NUCLEI. G. E. Brown and C. T. De Dominicis (Univ. of Birmingham). Proc. Phys. Soc. (London) A70, 668-80(1957) Sept.

The relation of the complex well which is used to describe average features of the scattering to dispersion theory is discussed. A model is employed in which the compound states have an underlying single-particle structure. It is shown that a complex well can be defined which reproduces the average scattering phase. The imaginary part of this well is simply related to the absorption. (auth)

13539

DIRECT INTERACTION AND NUCLEAR DISPERSION THEORY. G. E. Brown and C. T. De Dominicis (Univ. of Birmingham). Proc. Phys. Soc. (London) A70, 686-9(1957) Sept.

The problem of inelastic scattering of several Mev nucleons is formulated in nuclear dispersion theory. The case where the residual nucleus is left in a state of low excitation is considered in detail. Contributions from the distant compound-nucleus levels can be summed explicitly and give an expression similar to that usually employed in the theory of direct interaction to calculate differential cross sections. Contributions from the near compound-nucleus levels contribute in a complex fashion, and cannot explicitly be summed. It is assumed that phase relations can usually be neglected for them, and they, then, are responsible for the compound-inelastic scattering. (auth)

13540

POLARIZATION EXPERIMENTS IN PROTON-PROTON SCATTERING. T. V. Kanellopoulos and G. E. Brown (Univ. of Birmingham). Proc. Phys. Soc. (London) A70, 690-702 (1957) Sept.

Possible proton-proton polarization experiments and the information that can be gained from them are reported. The formalism is given and formulas are listed from which a quantity which can be measured in such experiments can easily be obtained in terms of the theoretical quantities. The formalism of the statistical matrix for spin $\frac{1}{2}$ particles and the representation of the scattering matrix in spin space are employed. The chief aim of this paper is to present a complete set of formulas covering all experiments which appear to be possible in the near future. The formalism to be employed is introduced and an elementary discussion of polarization phenomena is given. Results of the algebra needed to carry out the analysis of experiments are given, and these are used to show what quantities the experiments determine. (auth)

13541

ANALYSIS IN COINCIDENCE IN PROTON-PROTON SCATTERING. G. E. Brown and T. V. Kanellopoulos (Univ. of Birmingham). Proc. Phys. Soc. (London) A70, 703-7(1957) Sept.

An elementary discussion of experiments involving analysis in coincidence is given. The case in which the incident beam is unpolarized is discussed in detail. Additional information that can be obtained if the incident beam is polarized is indicated, and the additional information which can be obtained with a magnetic field is briefly summarized. (auth)

13542

A MODEL FOR THE INELASTIC SCATTERING OF NUCLEONS. Sueji Okai (Kyoto Univ., Japan). Progr. Theoret. Phys. (Japan) 17, 308-10(1957) Feb.

The curve of the predicted level density plotted against excitation energy of residual nucleus is concave downward according to the statistical theory in disagreement with experiments. Furthermore, the experimental results indicate that the observed energy variation of the level densities may not depend on the excitation energy of residual nucleus primarily, but, instead, there is some evidence that it is a function of the energy of emitted protons. It is pointed out that these conflicts are due to the single-particle aspect of nuclear behavior in the compound system. A model is proposed for the description of the energy exchange between the incoming nucleon and the target nucleus. (M.H.R.)

13543

LOW'S SCATTERING EQUATION AND S-MATRIX. Hideo Fukutome (Kyoto Univ.). Progr. Theoret. Phys. (Japan) 17, 383-400(1957) Mar.

Without reference to the details of the interaction, Low's scattering theory is formulated including scatterings of bound particles. The Low equation is derived in two forms: the differential form in the Heisenberg representation, and the form like the second order perturbation formula in the Schrödinger representation. Corresponding to the state used as the comparison state, there exist various types of the Low equation and expressions of the S-matrix. From these Low equations the symmetry properties of the S-matrix are deduced. Using the differential form of the Low equation, it is shown that the Low equation in which the comparison state is the vacuum can be linearized, and has infinitely many solutions as has been pointed out by Castillejo et al. (auth)

13544

REMARKS ON THE ELASTIC SCATTERING OF DEUTERONS BY HEAVY NUCLEI. Yoshihiko Nishida (Saga Univ.). Progr. Theoret. Phys. (Japan) 17, 506-8 (1957) Mar.

The best fit for the deuteron data led to the poor result that the mean free path of the deuteron near the center of the nucleus is much longer than that of the alpha particle. The situation becomes worse if the effect of electric break-up of the deuteron is taken into account. It is pointed out that this curious result may disappear by introducing the loosely bound character of the deuteron into the nuclear absorption, and that the critical angle at which the deviation from the Coulomb scattering begins can be related to the electric breakup of the deuteron. (M.H.R.)

13545

ON THE ELASTIC SCATTERING OF CHARGED PARTICLES BY NUCLEI IN THE INTERMEDIATE ENERGY REGION. S. N Ghoshal and B. B. Baliga (Inst. of Nuclear Physics, Calcutta). Progr. Theoret. Phys. (Japan) 17, 556-60(1957) Apr.

An expression was obtained for the differential cross-section for the elastic scattering of intermediate energy charged particles by heavy nuclei, using a complex potential and employing the variational method due to Montroll and Greenberg. The potential considered is of the type V =

$-(V_0 + iW_0)$ inside the nucleus and zZe^2/r outside. The expression obtained for the differential elastic scattering cross-section was used in the case of scattering of 32Mev protons from Au. These were compared with the experimentally determined cross-sections. It was also shown that the present method of calculation gives results which are in good agreement with those obtained by using the partial wave method. (auth)

13546

SATURATION OF NUCLEAR FORCES. NEUTRON PROTON SCATTERING. A. B. Bhatia (Univ. of Alberta, Edmonton, Can.) and S. M. Shah (Physical Research Lab., Ahmedabad, India). Progr. Theoret. Phys. (Japan) 17, 561-6(1957) Apr.

With the help of a potential so chosen as to, in a sense, just satisfy the saturation requirements and the various experimental data on the deuteron, and nucleon-nucleon scattering at low energies, the neutron proton differential scattering cross-section $\sigma(\theta)$ is calculated at 100 Mev and 260 Mev in Born's approximation. The error due to the use of Born's approximation at 100 Mev is estimated. The calculated cross-sections are in fair agreement with experiment and indicate the desirability of making an exact phase shift calculation of $\sigma(\theta)$ for this potential. (auth)

13547

MULTIPLE γ SCATTERING EFFECT IN CYLINDRICAL SOURCES. E. E. Kovalev and V. I. Popov (Inst. of Biophysics, Moscow). Zhur. Tekh. Fiz. 27, 1621-3(1957) July. (In Russian)

Attempts were made to estimate the effects of self-scattering on the yield of radiation along the cylindrical source. (R.V.J.)

RADIATION EFFECTS

13548

MECHANISM OF ANNEALING IN NEUTRON IRRADIATED METALS. T. H. Blewitt, R. R. Coltman, D. K. Holmes, and T. S. Noggle (Oak Ridge National Lab., Tenn.). J. Appl. Phys. 28, 84-110(1957) June.

An evaluation is made of the various interpretations of the annealing spectrum which arises as a result of low-temperature irradiation. (auth)

13549

A NEW ATTEMPT TO EXPLAIN THE PHENOMENON OF COLOR CENTERS. D. Saint-James. J. phys. radium 17, 907-8(1956) Oct. (In French)

A modification of the Varley model is proposed which attempts to explain color centers in alkali halides and overcome difficulties interposed by electron resonance studies. An interpretation of the bleaching phenomenon is included. (T.R.H.)

13550

KINETICS OF ISOTHERMAL ANNEALING OF RADIATION DAMAGE IN SZILARD-CHALMERS REACTION WITH COBALT COMPLEXES. PART I. TRIS-ACETYLACETONE COBALT (III)-SECTION 1. Amar Nath, K. S. Venkateswarlu and Jagdish Shankar (Atomic Energy Establishment, Trombay, Bombay). Proc. Indian Acad. Sci. 46, 29-52(1957) July.

Part of a general comprehensive study of the thermal and radiation annealing of several irradiated cobalt complexes, which is ultimately expected to give some insight into the nature of the damage centres resulting from Szilard-Chalmers effect and other extraneous radiations is given. It has been found that the retention reaches a maximum characteristic of the temperature of annealing. For each temperature studied thermal annealing has been shown to follow first-order kinetics. The results of two-stage and multistage experiments show that the thermal history has a profound influence on the annealing behaviour. (auth)

RADIOACTIVITY

13551

QUANTITATIVE RADIOCHEMICAL METHODS FOR DETERMINATION OF THE SOURCES OF NATURAL RADIOACTIVITY. John N. Rosholt, Jr. (U. S. Geological Survey, Denver, Colo.). Anal. Chem. 29, 1398-1408(1957) Oct.

Study of the state of equilibrium of any natural radioactive source requires determination of several key nuclides or groups of nuclides to find their contribution to the total amount of radioactivity. Alpha activity measured by scintillation counting is used for determination of Pa^{231}, Th^{232}, Th^{230}, and Ra^{226}. The chemical procedures for the separations of the specific elements are described, as well as the measurement techniques used to determine the abundances of the individual isotopes. To correct for deviations in the ore standards, an independent means of evaluating the efficiencies of the individual separations and measurements is used. The development of these methods of radiochemical analysis facilitates detailed investigation of the major sources of natural radioactivity. (auth)

RARE EARTHS AND RARE-EARTH COMPOUNDS

13552

DETERMINATION OF THE OPTICAL CONSTANT OF NEODYMIUM IN THE VISIBLE SPECTROSCOPIC ZONE AND IN THE NEAR INFRARED. Eberhard Kern. Z. Physik 148, 38-52(1957). (In German)

The optical constant of Nd in the spectroscopic zone λ = 8800 A to λ = 3950 A is measured and is discussed on the basis of the electron theory of the metal. Reflection and absorption results are obtained by a film deposited by evaporation and measurement of intensity of reflected and transmitted light. (tr-auth)

13553

ZEEMAN EFFECT AND CRYSTAL STRUCTURE OF HEXAGONAL EUROPIUM ETHYL SULFATE. K.-H. Hellwege, U. Johnsen, H. G. Kahle, and G. Schaack. Z. Physik 148, 112-27(1957). (In German)

The Zeeman effect of the visible absorption spectra is studied at high temperatures with high resolution and using polarized light. (tr-auth)

SHIELDING

13554 IGE/R-3

United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs. England.

THERMAL STRESSES IN REINFORCED CONCRETE SHIELDS. W. Bonsall. Oct. 1955. Decl. May 8, 1956. 16p. (IGC-SWP/P-26).

Thermal stresses in a reinforced concrete slab are analyzed assuming that the temperature is a function only of distance into the slab from one face. It is shown that under certain conditions of temperature distribution and constraint only a nominal amount of reinforcement is required. Under other conditions it is shown that it is not possible to design a reinforced concrete shield which will not be overstressed. The relative advantages of thermal shield and reinforcement are indicated. Recommendations are made for further experimental work. (auth)

SPECTROSCOPY

13555

NEW ATOMIC ENERGY LEVELS IN THE Mn II SPECTRUM. Laura Iglesias (Univ. of Madrid, Spain). J. Opt. Soc. Amer. 47, 852-7(1957) Sept.

Seventy-one new atomic energy levels of Mn II have now been discovered: 31 even and 40 odd, belonging to the $3d^6$, $3d^54s$, $3d^54p$, $3s^55s$, $3d^55d$, and $3d^57f$ configurations. With these levels it has been possible to classify 324 lines. Moreover, 106 additional lines have now been classified with levels already known. (auth)

THEORETICAL PHYSICS

13556

METHOD OF MOMENTS IN QUANTUM MECHANICS. Francis R. Halpern (Univ. of California, Berkeley). Phys. Rev. 107, 1145-7(1957) Aug. 15.

An approximation technique for quantum-mechanical problems based on the expectation values of the powers of the Hamiltonian is developed. The mathematical foundations on which this approach is based are the method of moments employed in probability theory, and the theory of orthogonal polynomials. In practice this method constitutes an extension of the Rayleigh-Ritz principle and gives a systematic method of improving the trial function. (auth)

13557

SOME THEORETICAL CONSEQUENCES OF A PARTICLE HAVING MASS ZERO. Sidney A. Bludman (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev. 107, 1163-8(1957) Aug. 15.

When the mass is zero, the operator γ_5 commutes with the Hamiltonian of a noninteracting spinor field. This leads to the possibility of a two-component neutrino that has been employed in connection with parity-nonconserving neutrino reactions. Every representation of the full inhomogeneous Lorentz group describing a free particle of arbitrary nonzero spin can be split in the same way when the mass is zero. In particular, a reduction of the free electromagnetic field from six components to three, is exhibited in a way exactly analogous to the reduction of four-component massless spinors to two components. This illustrates the fact that parity nonconservation, when it occurs, cannot be a result of any intrinsic property of a free field, but must, instead, be ascribed to particular interactions occuring in nature. The possibility of relating the γ_5 degeneracy of the massless spin one-half field to its invariance under conformal coordinate transformations is discussed. The two-component free Dirac particle is invariant under the conformal point transformations, and also under the reciprocal radius transformations. Some different definitions of the conformal group are distinguished. (auth)

13558

QUANTUM FIELD THEORY OF UNSTABLE PARTICLES. Huzihiro Araki, Yasuo Munakata, and Masaaki Kawaguchi (Kyoto Univ.). and Tetsuo Goto (Osaka Univ.). Progr. Theoret. Phys. (Japan) 17, 419-42(1957) Mar.

Two methods of the renormalization are proposed for unstable particles. One is connected with the resonance in scattering and the other with the time development of the unstable particle state. The relation between the two formulations is discussed. Arbitrariness in the choice of the renormalization procedure comes from the uncertainty principle of the quantum mechanics. (auth)

13559

SOME IDENTITIES FOR RENORMALIZATION CONSTANTS IN S(S) AND PS(PS) MESON THEORIES. Kichiro Hiida (Univ. of Hiroshima). Progr. Theoret. Phys. (Japan) 17, 520-1(1957) Mar.

Using the approach to a solution of the quantum field theory presented by Landau, Abriksov, and Khalatmikov, it is shown that there exist some identities between the renormalization constants Z_1 for S(S) and PS(PS) meson theories. (M.H.R.)

13560

MATHEMATICAL FORMULATION OF THE GELL-MANN-NISHIJIMA SCHEME FOR NEW PARTICLES. Sigeo Hanawa (Tokyo Gakugei Univ., Japan). Progr. Theoret. Phys. (Japan) 17, 592-602(1957) Apr.

It is shown that the theory of d'Espagnat and Prentki (henceforth referred to as DP) on a mathematical formulation of the Gell-Mann-Nishijima scheme can be generalized so as to accommodate particles of higher isofermion number. Modifications made for this purpose are: (i) the isospinor formalism is adopted for all kinds of particles instead of DP's isospinor-isotensor mixed formalism; and (ii) the invariance under inversion of isobaric spin space, imposed by DP as a postulate on strong and electromagnetic interactions, is replaced by the invariance under a continuous phase transformation group G_U generated by the operator U representing isofermion number. These modifications lead not only to extension of the framework but also to refinement of the theory as follows. In our formalism, (a) the transformation properties of field variables with respect to G_U are unambiguously determined without resort to the assumption, made by DP, that only the Yukawa interactions appear in the interaction Lagrangian: (b) the isofermion number U proves to be the number of suffices of the first kind minus that of the second kind, with respect to inversion, of the isospinor describing a particle: and (c) DP's identity $Q = I_3 + \frac{1}{2}U$ among the electric charge Q, the third component of isobaric spin I_3, and U as well as Racah's identity $P = \exp(i\frac{1}{2}\pi U)$ between U and the isobaric parity P follows directly from an identical relation among the transformation groups concerned. (auth)

URANIUM AND URANIUM COMPOUNDS

13561 ANL-5539

Argonne National Lab., Lemont, Ill.

EFFECTS OF HIGH BURNUP ON NATURAL URANIUM. J. H. Kittel and S. H. Paine. May 1, 1957. 45p. Contract W-31-109-eng-38. $1.25(OTS).

Results are given from experiments in which unrestrained specimens of unalloyed natural uranium were irradiated to total atom burnups ranging up to 1.82% (15,500 Mwd/t) at temperatures from 50 to 220°C. A few specimens were also thermally cycled. The specimens represented material with four different fabrication histories: (1) rolled at 300°C, (2) rolled at 300°C and quenched from the β phase, (3) rolled at 300°C, quenched from the β phase, and recrystallized in the α phase, and (4) rolled at 600°C. It was found that the 300°C rolled specimens in the as-rolled condition grew in length at a rapid rate when subjected to irradiation, although they maintained relatively smooth surfaces. The growth rate of this material appeared to decrease with increasing irradiation temperature. The beta quenched specimens were much more stable dimensionally but developed roughened surfaces. The 600°C rolled material showed intermediate behavior. It was concluded that 300°C rolled and beta quenched U can withstand at least 2 at. % burnup without disintegration due to irradiation damage. A qualitative similarity was found between the irradiation growth rates of the four materials and their growth rates under thermal cycling. (auth)

13562 CEA-672
France. Commissariat à l'Énergie Atomique, Paris.
ETUDE DE LA DIFFUSION URANIUM–ZIRCONIUM. (Study of Uranium–Zirconium Diffusion). Y. Adda, C. Mairy, and P. Bouchet. Feb. 1957. 33p.

13563 HW-47884
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
DOPPLER COEFFICIENT OF A DILUTE SYSTEM OF U^{235}. M. V. Davis. Jan. 18, 1957. Decl. Feb. 6, 1957. 3p. Contract [W-31-109-Eng-52]. $1.80(ph OTS); $1.80 (mf OTS).

Experiments conducted in the Hanford Test Pile yield the result that cylinders containing U^{235} at densities less than 0.35 gm/cm^3 will have a zero Doppler coefficient in the temperature range from 50 to 500°C. (auth)